THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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TECHNICAL SOCIETIES AND SECRECY.

MR. C. F. SCOTT delivered an interesting Presidential address to the American Institute of Electrical Engineers at its 168th meeting held in New York in September, discussing the growth of the electrical industry in the States and elsewhere, and considering the effect which the Institute has, and the far greater effect it ought to have, upon that industry. Twenty-seven years ago, when the society was founded, half its officers were identified with the telegraph, and the capital invested in electricity outside telegraphic and telephonic work did not exceed $1,000,000. Now there has arisen a generation of electricians "to whom the click of the sounder is unintelligible," and the total capital sunk in electrical undertakings approaches $4,000,000,000. The Institute numbers 1,546 members; but if it bore the same relation to the kilowatt capacity of the power stations of the country as does the British Institution to those in the United Kingdom, its members should be 25,000. Five per cent of the members attend the meetings, and 2 per cent. read papers. Of these papers 20 per cent. come from professors, 25 per cent. from consulting engineers, and 45 per cent. from engineers employed by manufacturing companies. This last analysis of the derivation of the papers communicated to the American Institute is worthy of attention, for it shows that the manufacturing concerns of the States are keenly alive to the importance of the so-called scientific side of their business, employing technical advisers who are competent to do work fit for publication, and permitting those advisers to publish the results of their researches. A spirit is too often met with in this country which leads the employer to refuse permission for the publication of work done in his laboratory, even when he is willing properly to finance a laboratory in which respectable work can be done. There are, of course, some secrets in all branches of manufacturing; but, during the invention or control of industrial processes, important new discoveries are constantly being made, which, buried in private note books, are of no more pecuniary value to the proprietor of the factory for being hidden from the world. Broadly speaking, and reviewing equally all departments of manufacture, there are really very few secrets deserving the name; for the manufacturer who fondly imagines that he is making a certain article by a special process known only to himself, who swears his employés to silence, and builds a brick wall round his works, forgets that by so doing he prevents the infiltration of new ideas among his staff, and remains blissfully ignorant that all his rivals are employing identical methods, with the exception of those who have effected improvements many years ago.

It is owing to this constant dread of having his brains picked—when perchance there is nothing in them worth picking—which seems to be specially characteristic of the Englishman, that technical, as opposed to purely scientific,

societies do not always flourish so well here as abroad. The English member of a certain trade often fails to appreciate the truth of Mr. Scott's remark that while each has his individual interests, there is a general interest common to all. Most of the members of a technical society may be trade rivals, striving all day long to prevent each other getting orders and work; but they have alike one or more common foes, and it ought to be possible for them to meet of an evening amicably to devise methods of overcoming those foes, offensive and defensive methods which shall assist all indifferently, without unfairly benefiting one. There is sometimes to be encountered among British manufacturers a most reprehensible practice of depreciating the value of all their rivals' products when they are talking to a possible customer, instead of limiting their remarks to an advocacy of their own merits. Repeated two or three times by different men in different offices to the same layman, this habit causes the customer to be lost to the trade altogether; for after calling upon half a dozen firms, the customer has received five separate expert opinions that the goods sold by each firm are bad, and only one (which is *ex parte*) that they are good and fit to be purchased. After such treatment as this, no surprise need be felt if the layman seeks and finds some totally different way of fulfilling his requirements, avoiding completely the industry which has taught him such a lesson of inefficiency and internal dissension; while at the same time he is tolerably certain to go round among his friends and acquaintances, recounting his experience, and warning any of them who may contemplate becoming customers of any single firm in the trade, that he has the best of reasons for knowing that the company is bad and its products worse.

Professional Etiquette.

We reproduce below the substance of a circular letter which has been sent by the Council of the Institution of Electrical Engineers to the clerks of some of the larger counties and boroughs. The letter reveals the depths of bad form to which some professional men have knowingly descended in their search for work, and local authorities in their natural ignorance of the dictates of good taste. The average tradesman with a seat on the Borough Council may be an honest man and a good fellow, but he is no more likely to comprehend the fundamental principles of correct professional conduct than he is to understand the management of an electrical supply undertaking. There is some excuse for the councillors, but there is little for their clerks, who very well know, from their own rigid rules of conduct, that to advertise or to answer an advertisement for professional services is a gross breach of etiquette. Still less can the engineers be exonerated from blame who, by responding to such advertisements, and by touting for work, directly or indirectly, have rendered necessary this strong action on the part of the Institution. That some such action was urgently needed was well known—to none more so than to the technical press. Time after time we ourselves have drawn attention to the constantly declining standards of professional conduct. What is really wanted is, apparently, some such power as is vested in the Law Society and the Medical Council, by which every *soi-disant* consulting engineer should be required to possess full qualifications for the post, and to act in accordance with the dictates of etiquette, on pain of being "struck off the register" in case of default. As a matter of fact, we believe that the respective Institutions already possess this power, if they care to exercise it.

A point which certainly demands attention is the tendency of civil and mechanical consulting engineers to invade the domain of their electrical *confrères*, on the somewhat thin basis that "electrical engineering is a branch of mechanical engineering." So it is—and so are shipbuilding and plumbing. Yet we never hear of a naval constructor giving advice *re* water pipes. The fact is, that electrical engineering is regarded as lawful prey by members of the older professions, not because they know anything about it, but because they have acquired a certain standing and connection in their own special lines, their clients do not know enough to distinguish between the familiarity born of experience, and that bred of books, and—there are always lots of skilled assistants to be had cheaply, to do the real work!

If our own Institution could confer with its elders, and establish some line of demarcation to keep these rapacious intruders within legitimate bounds, a vast amount of bad work due to inexperience would be avoided, and there would be the less occasion, thanks to the greater number of "jobs" open to them, for such offences as those stigmatised in the letter in question:—

Institution of Electrical Engineers.

28, Victoria Street,
Westminster, S.W.
October 17th, 1902.

Sir,—As it has come to the knowledge of the Council of this Institution, that in several cases consulting engineers have applied for employment, and in others local authorities have advertised for consulting engineers, I am instructed by the Council to forward a copy of the code of etiquette in such matters that, in their opinion, ought to govern all those belonging to the Institution.

I am also instructed to urge upon you the great importance of having electrical work well done at the most moderate outlay; and would point out that by advertising, or by employing those who solicit employment either directly or by agents, local authorities may deprive themselves of the services of electrical engineers of high standing and great experience.

I have the honour to be, Sir,
Your obedient servant,
W. G. McMillan, *Secretary*.

Standard of Professional Etiquette for Consulting Electrical Engineers.

As approved by the Council of the Institution of Electrical Engineers, July 16th, 1902.

1. No consulting engineer should solicit employment as consulting engineer verbally, by letter, by agent paid by commission or otherwise, or by any other means.
2. No consulting engineer should answer advertisements for consulting engineers.
3. No consulting engineer should advertise for employment.
4. No consulting engineer should pay by commission or otherwise anyone who introduces clients.
5. No consulting engineer should receive trade or other discount, or surreptitious commissions or allowances in connection with any works which he superintends.
6. A consulting engineer who is also directly or indirectly interested in any contracting or manufacturing business should inform his client in writing what his connection is with such contractor.

However, there are two sides to every question; and for an excellent exposition of the other side of this one, we refer our readers to an article on "The Theory and Practice of Getting Jobs," reproduced in our issue of Feb. 16th, 1900.

Submarines and Wireless Telegraphy.

A few weeks ago it was announced in some of the French papers that experiments bearing upon the practicability of communicating with submarines by wireless telegraphy had been carried out successfully. In the experiments made on British ships it appears that, although no difficulty was experienced in transmitting messages to the vessel, there was no reply forthcoming. This, of course, is a serious disadvantage, for there is no means of ascertaining that the message has been correctly received. Of course the whole question is only in an experimental stage at present. An aerial mast is a very objectionable fitting, as it offers a large amount of resistance to the progress of the boat. We understand that experiments in this direction are still being carried out in Portsmouth harbour, while the submarine is alongside her parent ship the *Latona*. The importance of the subject needs no emphasis.

ELECTRO-METALLURGICAL PROBLEMS.—III

By ALEC. A. BEADLE, A.I.E.E., F.C.S.

Zinc.

Zinc occurs in nature chiefly as blende (Zn S), and less frequently as zincite (Zn O), and calamine ($Zn CO_3$). Blende is generally associated with iron, arsenic, cadmium, &c.

The great difficulties of the present methods of reduction are well known. The ore is first calcined to oxide, then mixed with carbonaceous matter and distilled in large retorts, the volatilised zinc being condensed and cast into ingots, when it is known as spelter. In this form it contains iron and other impurities which detract from the value of the metal. The amount of fuel consumed, the loss of zinc during reduction, and the rapid deterioration of the retorts, as well as the large amount of handling required, all combine to render the distillation process both troublesome and expensive, so that a large field is here opened for the investigation of the electro-metallurgist.

In the endeavour to find an economical electro-chemical method for the reduction of zinc from its ores, very numerous and diverse suggestions have been made, some for bringing the zinc into solution, depositing the metal electrolytically, and others for converting the zinc into chloride, and electrolysing it whilst fused.

Among the many methods devised for obtaining zinc in solution, only a few may be said to be satisfactory; for instance, the blende can be roasted partly to sulphate, and extracted with sulphuric acid; but having obtained the zinc in solution, the metallurgist is now confronted with the greatest difficulty in the process, namely, that of electrolytically producing a thick and coherent deposit of metallic zinc. The spongy nature of electrolytic zinc is well known, and although it has been attributed to various causes by different investigators, all attempts to remedy the evil have been so far unsuccessful.

Fair deposits of zinc may, however, be obtained from the sulphate or the double sulphates of zinc and the alkali metals, or from zincates of soda or potash, with due regard to temperature, at current densities two or three times that used in copper refining, so that several successful processes are already at work, and giving good results for the galvanisation of iron.

Zinc, however, like lead, can be satisfactorily reduced from the fused anhydrous chloride, and this seems the most probable direction for future development.

Zinc chloride produced in the wet way has the remarkable property, possessed in less degree by many other salts, of retaining about 1 per cent. of water even when fused at a dull red heat. This has proved a great difficulty, as a considerable amount of current has to be used to decompose this water, which is liberated as oxygen and hydrogen, the former at a red heat attacking the carbon anodes. The amount of current necessary to liberate 1 grm. of hydrogen is the same as that required to deposit 32 grms. of zinc.

Steinhart, Vogel and Fry propose to dehydrate the chloride by means of a current of dry air in a partial vacuum. F. M. Lyte proposes to digest metallic zinc in the fused salt, or to use it temporarily as the anode. If hydrated zinc chloride be distilled at a bright red heat, the anhydrous chloride, together with hydrochloric acid, distills over leaving a residue of zinc oxide. Metallic zinc is liable to be deposited as "fume," but this is overcome by the use of fused zinc cathodes and by attention to dehydration and temperature. The question of producing chloride direct from the ore will be discussed later.

Zinc blende occasionally occurs in large deposits, very rich in silver, in Mexico and elsewhere, in which case when reducing the zinc a very large proportion of the silver contents is unavoidably lost; an electrolytic method based on the above principles might, however, enable the entire metal contents to be recovered.

Complex Sulphide Ores.

Perhaps the most abundant deposits of galena and zinc blende are those in which they are associated in more or less equal proportions, together with the sulphides of copper, iron, &c. The lead interferes with the reduction of the zinc and the zinc with the lead, so that it is necessary to find a method of separating these sulphides, or a process in which they would not interfere with one another.

Many such deposits occur in various localities, but the largest is the lower deposit of the celebrated Broken Hill lode of New South Wales. This consists essentially of galena containing silver, and zinc blende containing iron, with a gangue of quartz, garnets, rhodonite and felspar. It averages about 18 per cent. of lead, 25 per cent. of zinc, 6 per cent. of iron, 20 per cent. of gangue, 20 ozs. of silver and 2 dwts. of gold per ton, with traces of copper, arsenic, &c. The attempts made to concentrate and smelt this mineral are too numerous to comment upon.

The bulk of this ore is concentrated at the mines by jigging, and is separated roughly into three products, only one of which is of real marketable value, containing about 60 per cent. of lead, 10 per cent. of zinc, and 31 ozs. of silver; the tailings, which contain a good proportion of the metals, are discarded.

Experiments with the Wetherill magnetic separator have lately given good results; blende assaying 41 per cent. to 45 per cent. of zinc, 8 to 10 per cent. of lead, and 10 ozs. of silver, and representing 50 to 75 per cent. of that originally present, has been obtained.

The peculiar structure of these ores, however, makes it impossible to obtain any really reliable results on a small batch of ore, since the mixed crystals of blende and galena vary in size from that of a pea down to smaller than a pin's head, and whereas in one specimen the crystals may be entirely separated by coarse crushing, in another, even when crushed to a 60-mesh sieve, crystals of blende may enclose smaller crystals of galena, and *vice versâ*, so that it seems necessary, in order to get a complete separation of the minerals, to entirely chemically disintegrate or dissolve the complex mineral.

Both the concentrates above referred to are of value for smelting, since in one there is not sufficient zinc to prevent the economical reduction of the lead, and in the second the order is reversed, the zinc being reducable. When, however, the zinc and lead are present in nearly equal proportions, the ore, even when comparatively rich, may be nearly valueless for smelting. This, therefore, constitutes the problem of which so much has been heard, and for which such numerous electro-metallurgical suggestions have been made.

We may class all these suggestions under two headings:—(1) Obtaining the metals in solution, which is subsequently electrolysed. (2) Obtaining the metals in the form of fused salts, either directly or indirectly, and subsequently electrolysing the fused salts.

Most of the former have been based on the fact that in partial roasting, the sulphates are produced, so that when the partially-roasted ore is lixiviated with water or sulphuric acid, the sulphate of zinc dissolves, while that of lead remains insoluble.

In the Ashcroft process, ferric chloride was originally used as the solvent for the roasted ore, converting the zinc into soluble chloride, and leaving the lead and silver as an insoluble residue. The ferric chloride was regenerated by the iron anodes used in the electrolytic zinc extraction vats, and oxidised in the same vats by carbon anodes.

Almost every solvent has been patented, including the mineral acids, the alkali bisulphates, and the alkalis. The same difficulties arise, however, in almost every case; if only the zinc is brought into solution the insoluble residue can be smelted for lead, &c., although the zinc cannot be satisfactorily deposited. Usually both metals are brought more or less into solution, and the satisfactory electrolytic precipitation becomes almost an impossibility. Moreover, all the above-mentioned impurities, except the gangue, are dissolved too, and their rapid accumulation in the electrolyte becomes disastrous. Neither have any electrodes been found to withstand the prolonged action of sulphates and chlorides in solution when used as anodes. Lead, however, withstands a pure sulphate.

Glancing at the second kind of process, we at once see that, although the difficulties of manipulation are much greater, the principles upon which they are based promise to be of more economic value.

It has already been pointed out that the halogen salts appear to be best suited to this mode of treatment, and since chlorine is by far the cheapest of these, we may settle at once upon the chlorides. Several methods have already been devised and patented for obtaining the fused chlorides directly or indirectly from the mixed sulphides.

The first consists in dissolving the raw or roasted ore in hydrochloric acid, which is both primitive and unsatisfactory, and involves the evaporation and dehydration of the zinc chloride, or treating the wet ore with chlorine, which is supposed to convert the zinc into chloride.

Brewer proposes to roast the ore to sulphate, leach it, and convert it into chloride by means of calcium chloride. This chloride of zinc has to be evaporated from solution, fused, and then dehydrated. The dehydration may be effected by electrolysis, during which oxygen and hydrogen are evolved, or, as suggested in a patent by F. M. Lyte, the fused salt can be digested with zinc, which evolves hydrogen, forming basic chloride, or the zinc can be used temporarily as an anode.

Twynam has patented a method in which the ground ore is mixed with zinc chloride and raised to just below a red heat, whereby lead sulphide reacts to form chloride, which he subsequently dissolves out and separates from the zinc sulphide. The weak point of this is that these reactions being reversed in solution, the lead sulphide is reformed.

Larsen passes chlorine over the red-hot ore, forming chlorides of both metals and chloride of sulphur.

Ganelin fuses the ore in zinc chloride, which forms lead chloride, and leaves the zinc sulphide undecomposed, and from this he then recovers the silver and lead by replacement by metallic zinc, which regenerates the zinc chloride. The zinc blende is thus freed from the galena and can be smelted after leaching. This replacing action is, however, slow, and the lead is produced at the expense of metallic zinc.

Swinburne, and later Swinburne and Ashcroft, produced a process that seems to have overcome many of the difficulties inherent in the above, besides being entirely novel. In principle they hold the ground ore in a bath of molten zinc chloride, which acts on the silver and lead sulphides; chlorine is then passed through and acts upon the zinc sulphide, converting it into chloride, and this is conducted in such a way that sulphur, and not chloride of sulphur, is evolved.

This they propose to do either at the surface of a carbon anode immersed in the melt, or by blowing the chlorine through the mass contained in a converter, when, it being an exothermic reaction, the temperature is kept up to the required pitch. The chlorides of lead, zinc, silver and other metals present are thus produced, and the metals can be fractionally electrolysed out, or the impurities removed, at will.

This process thus obtains the whole of the metallic contents, and recovers the sulphur.

The economic results of these various methods remain to be seen, but they seem to indicate the direction in which successful development is likely to be made.

ELECTRICITY SUPPLY—MUNICIPALITY AND COMPANY.

"Comparisons," said the worthy Mrs. Malaprop, "don't become a young woman," and Dogberry—the representative of the local authority—called them "odorous."

In trying to compare results from accounts prepared under essentially different systems, the remarks of both the classical personages we have quoted are applicable. If the municipal authorities and the companies kept their electricity accounts precisely upon similar principles, there would, of course, be no difficulty in comparing them; but their methods differ essentially, nor do either companies or municipalities respectively adopt absolute uniformity.

The Board of Trade have framed forms of accounts for local authorities and companies, which differ in one essential particular, viz., in the provision for depreciation in the case of private enterprises, but not when the supply is undertaken by a municipality. Unless the accounts in all cases are kept upon the same principle, comparisons as to actual results are of little value.

An esteemed contemporary has endeavoured to compare the performances of the local authorities with those of companies in electric supply, but the conclusions it arrives at in its compilations from the well-known tables of another contemporary are necessarily valueless, owing to the above considerations, apart from the fallacious arguments used in making the comparisons.

The Board of Trade returns are confessedly imperfect, and we agree that there is no valid reason why they should not have been brought up to date; but, on the other hand, our contemporary overlooks the fact that the electricity accounts of local authorities are not subject to audit by the Board of Trade, and that department is not answerable for them.

It is also important to remember that in numerous cases the auditors of municipal accounts have found serious fault with the system upon which they are kept, notably those we have from time to time referred to in relation to the Croydon Corporation, as well as to the recommendations of the Institute of Municipal Treasurers and Accountants (Incorporated) which they embodied in their report last year.

The conclusion at which our contemporary arrives, viz., that municipal electrical engineers and electric lighting committees manage their undertakings better than electric lighting companies, is based upon a comparison which is wholly unjustifiable, and which will not bear investigation.

No one will contend that company management is infallible, or universally successful, but to assume from the comparison of the published accounts that municipal control secures results better than, or even nearly as good as, private enterprise, is a very large assumption indeed.

It is assumed, for example, that because the accounts rendered show in the metropolitan area an average cost to companies of 2·59d. per unit sold, and only 2·38d. to local authorities, and that the charge per unit sold averages 32 per cent. more in the case of companies than in that of municipalities, therefore, private trading is at a disadvantage, but this, as we contend, depends upon the methods upon which the accounts are kept, and a comparison of the localities in which the supplies are given.

Take the average capital expenditure per kilowatt installed in the City of London by companies, and compare it with the costs in other parts of the metropolis, and the fallacy of any general average being taken for the purpose of deciding upon the question of management is seen at once.

Thus it has cost the City of London Co. £106 per kilowatt to instal their system in the City, where the street works are far more expensive than in any other locality, and yet the local authority of Islington, where the conditions are far more favourable, spent over £119 per KW. At Bedford the Corporation spent £121 10s. per KW., while at Altrincham a company installed a plant of the same capacity for less than £90, and so we might go on comparing one town with another, but we should be sorry to infer from these examples that it was solely management that caused the difference in price, when local circumstances and market values affect the whole question.

Local authorities were not the pioneers of electricity supply, but entered the field as traders under much more favourable conditions than the early companies, a circumstance which also affects any attempt to settle the question of management by such comparisons as our contemporary has instituted, under a system of averaging altogether dissimilar factors.

The average cost per unit sold is also alleged as evidence in favour of municipal trading—another fallacy—for the price to be charged must vary with the local conditions of supply, and no average is practical for any useful purpose, besides which it by no means follows that the lowest price charged indicates the best management if the companies' rate of 4·72d. leaves a fair profit, and the local authorities 3·58d., a considerable loss. The credit of good management is due to the companies.

The financial results in the Metropolitan area, as shown in the table from which our contemporary takes its figures, are as follows:—

Local authorities—surplus	9·410
Deficits	4·931
Profit claimed	4·479

but if a fair amount to cover depreciation, antiquation, and renewal of plant is provided, the trading will show an enormous loss; 3 per cent. upon the capital expenditure of £1,448,000 would amount to £43,440.

Our contemporary in compiling its statistics, separates the metropolitan from the provincial undertakings, but a still further sub-division would be necessary to arrive at any reasonable comparison, for, as we have shown, the cost of street works varies considerably in different localities, and to claim that the corporations of the metropolis *outside* the City area are entitled to any credit for their average expenditure being below that of companies working *within* the City, cannot be justified. For instance, it cost the City of London Co. £106, against £94 by the Borough of Stepney; but how does this prove that municipal management is better than that of companies, unless the cost of street works and land, for example, is the same in both cases; but it is clear, as we have shown, that the cost at Islington was higher, although it should have been much lower, than an installation in the streets of the City of London.

The fact is, that even if it were necessary to settle the question of municipal trading by a comparison of profit and loss accounts, the data do not exist, and the whole matter must be dealt with on the broad principles of socialism *versus* private enterprise.

In the advocacy of these principles, *pro* and *con*, exaggerations and errors are, to a certain extent, unavoidable; but the broad questions remain as to whether private trade should be abolished, and if it is wise or necessary for municipalities to enter upon trading at all.

Municipal *enterprise* and municipal *trading* are entirely different things; the former may enrich the town, whereas the latter may involve it in ruin.

TESTING, AND OTHER THINGS.

By N. C. WOODFIN.

(*Concluded from page* 653.)

Once a small 100-volt shunt dynamo, with a fly-wheel attached, was to be tested, and the favourite plan of first testing it by running it as a motor on no load was adopted. Almost any rheostat would do for a starter. As it happened, a starting switch was put in circuit that had been designed for a 500-volt 5-H.P. motor, and it was not numbered either for voltage or resistance.

The connections were as follows, this being a common way of connecting-up starting switches :—

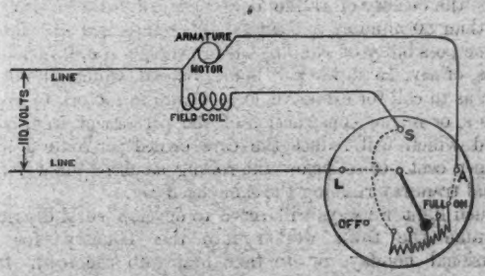


Fig. 1.

By the way, observe that when a starter is marked on its three terminals, A, L and S, there can be no mistake about line armature and shunt. When, however, a maker puts on two letters, M and S, or one, M only (since the shunt is usually indicated by the smaller terminal) there is no means of knowing, without seeing the inside, whether motor or main is meant. On turning on the current, with the above-mentioned starter on its first stop, the little 100-volt machine soon ran up to about three-quarters of its full speed. On moving the starter up towards the full-on position, the machine immediately began to race, and had to be stopped.

Naturally, the last thing to be discovered in the arrangements was the fact that using this high resistance starter weakened the field magnet enormously by cutting down the shunt current, and so caused the great increase in speed. For the resistance of the shunt was 40 ohms, and the total resistance of the starter turned out to be about the same.

Testing-rooms belonging to a user or supply authority exhibit a wider range of equipment than those of a maker, who not infrequently illustrates the proverb that the shoemaker goes the worst shod. A central station is free to select the most suitable apparatus and standards on the market, but a factory generally tries to meet its own needs. One has seen standard instruments employed for preliminary testing where a simple high-resistance lineman's galvanometer would be much more efficient. A department lacking this and a Wheatstone bridge for its own use, and testing and turning out 50 instruments of different kinds a week, would seem to be working at a disadvantage.

Sometimes different combinations of batteries for various currents are made by an arrangement of copper bars and clips, and regulation is obtained through the cutting in and out of circuit of platinoid resistances, using copper clips, and finally adjusting by means of a revolving rheostat. This system for ordinary ammeter work is superior to the arrangement of mercury connections that some use. These latter are, however, useful for small currents, and where space is limited, and allow of cross-connections being more readily made, these being required for testing central zero instruments, and in some other cases. Mercury connections are thus to be desired where it is necessary frequently to reverse the direction of the current. Tinned cables and mercury do not agree, the latter will sometimes creep a long distance inside the insulation, and come out the other side of a room if the wires may so happen to be between a couple of testing boards; but clean, bare, single-copper wires led a short distance vertically down into the mercury troughs, last well with very little of the creeping nuisance. If such and similar testing boards were kept covered when not in use, greater freedom from dust would ensue.

It might be said that in almost all branches of electrical work the subject of insulation does not receive the attention it deserves. Some electricity supply works may not merit this stricture, and there ought to be a lot of information available that is not made public. One would think that if a number of insulation tests of installations and large apparatus, taken periodically, and extending over a period of five years or more, could be obtained, accompanied by apt remarks on the state of the thing tested, much could be learnt from such results. If any have such records, what is the use of keeping them secret?

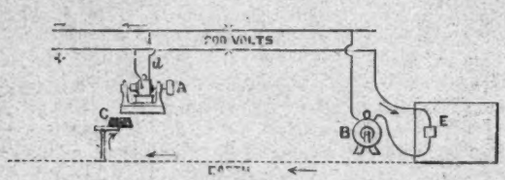
But if owners of large private installations could be persuaded to have thorough insulation tests taken, say, triennially, an examination of the changes in insulation resistance for a few seasons might reveal a good deal of interesting information, some of which would be useful in showing where deterioration occurred, so anticipating breakdowns, and affording an impartial judgment on the materials used by different engineers and manufacturers.

Rough insulation tests might well be taken in large motor installations at least once a month by the man in charge, who could be supplied with a high resistance detector galvanometer, to be used on the ordinary circuit of, say, 200 volts.

The instrument might have a couple of marks on the dial, "caution" and "danger;" when the deflection lay between the two, he should be instructed to watch any such circuit oftener; when the deflection came above the second mark, he would have to report this to the manager, who might order any such circuit to be put out of use till the fault had been removed. For medium-sized motors, perhaps values of 50,000 and 10,000 ohms might be selected for the two galvanometer marks.

Here is such a breakdown as might occur where insulation tests are unknown :—A (fig 2) is an open motor driving lathes by belting, with one pole, *d*, partly earthed, on frame through dirt, but the machine itself is tolerably well insulated from earth by a

wooden floor, and a labourer is filling the oil cups on the bearings and standing on a floor light, C, at the side of the motor. A floor light with its small squares of glass bedded in an iron grid, and perhaps with its under side at one corner resting close to an iron pillar, may form an unsuspected good contact with earth. B is an enclosed motor driving a punching and shearing machine in a yard some way off, an ironclad starting switch being bolted on to the side of the punch, E.



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The fact that insulation tests are so often neglected has, perhaps, allowed the erroneous impression to get abroad among men who get the job of looking after electric installations in factories that a partial earth on one pole of a machine is of no consequence.

Really, working under such conditions is like travelling in a railway carriage with one of the doors unfastened, by which an accident may occur at any time.

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By FRANK BERRY, Jun.

One of the most important factors in the successful operation of a street railway is the condition of the car brakes. On a road where hand brakes are used, there are generally more cars turned in for bad brakes than for any other cause. Among the most frequent faults in the action of brakes are hard pulling, sliding or skidding of the wheels, kicking and binding of the brake shoes.

The principal cause of a hard-pulling brake is insufficient leverage. Under certain conditions a car will pull up all right from one platform, while from the other platform the brake may pull very hard. This is usually caused by one end having more leverage than the other, or one pair of shoes being set closer to the wheels than the other pair. Under this condition, setting all the brake shoes at the same distance from the wheels will make the brake pull alike from both ends of the car. If, however, more leverage is required, the equaliser rods must be pulled together at the turn-buckle.

It is well known that when the winding stem has a great deal of leverage the brake shoes will wear the chill off the wheels much quicker than if less leverage were allowed, and when the chill is worn through the wheels very quickly develop flats. It should be borne in mind that a car can ordinarily be pulled up with about 1½ turns of the brake handle, and the brake rigging should be set correspondingly.

Care should be taken also to make sure that the brake shoes do not rub against the wheels when the brake-stem is released. This condition can easily be detected by sounding the car wheels with a small hammer. If the wheel rings when it is struck, this is a sure indication that the brake shoe hangs clear, but if no ringing sound is obtained the shoe should be drawn away from the wheel until the latter rings upon being struck.

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The sliding or skidding of car wheels is, of course, due to too much leverage, or else to an irregular spacing of the brake shoes. The remedy for excessive leverage is to let out the equalising rods at the turn-buckle. The remedy for irregular spacing of the brake shoes is obvious.

The kicking or chattering of a brake beam is confined to double-truck cars, and is caused by a flange being formed on the outer side of the brake shoe due to wear; these flanges, when the brake is applied, bind against the outer sides of the car wheels until the brake beam is drawn up against the kicking shoes immediately above it. Regular inspection will, of course, disclose the fact that these flanges are being formed, and as soon as the flange reaches an appreciable height it should be promptly chipped off.

It is also a common occurrence that kicking or chattering by the brake beam is caused by excessive wear, which allows the brake beam to drop below the normal position. In this case the kicking shoes should be lowered slightly. Care should be taken, however, that the kicking shoes are not set too close to the brake beam, as this will interfere with the good braking qualities of the rigging.

The binding of brake shoes against the wheel treads occurs mostly in cold weather, when it is due to the freezing of water thrown on the brake rigging in washing up. A car that is shoe-bound from this cause can easily be put in good condition as to its brake rigging by melting the ice with salt and applying hot oil on the wearing parts. Failure of the brakes to release is also caused by weak or broken releasing springs, which, of course, should always be displaced by new ones.

It is scarcely necessary to point out that the brake rigging of all cars should be frequently and thoroughly inspected by men who are fully competent to adjust the rigging properly, since the safety of passengers and employés depends upon the proper action of the brakes.

ELECTRIC TRAMROADS OR LIGHT RAILWAYS.

Our energies in England have been applied so far chiefly to building urban and interurban tramways proper, but the near future will see a great development in the direction of light electric roads built after the style of the steam roads, and connecting outlying towns and villages with their pre-eminent centre. These light railways will exploit such properties as the heavy steam roads and the solidly constructed tramway could not touch with profit. They will be built as lightly as is practicable, and economically possible, and will be constructed on the waste of the high road, on the high road itself, or through private land, as occasion or necessity demand.

The capital expenditure per mile being comparatively light, the enterprise will not be killed if, during the first few years, the density of traffic does not call for a headway of less than 30 minutes, and capital will be lessened still further by the possibility of running at an average speed, including stops, of say, 15 miles per hour, a speed which is not so high as to call for excessive expenditure in motors or power houses, or in the construction of the permanent way, but a speed which will reduce the cars owned per route mile by 70 per cent. or so below the rolling stock required for an actual tramway running the same headway.

Such light railways will serve to develop rural districts; to take the town worker into the country for an occasional holiday, or to take him into the town from a permanent country residence; and, at the same time, to act as feeders to the urban tramways and the heavy railways. The development of such light railways has been retarded, and will continue to be retarded, by the municipalisation of urban systems, which prevents the free linking of towns by its narrow boundary policy. Consider the case of two towns separated by 10 miles of rural district, both towns owning their tramways. Neither can join the other, and the towns remain congested, while the rural district remains undeveloped; for, unless the latter contains many villages, the prospects of gain are not sufficiently

bright to induce private enterprise to run from the boundary of one town to the other. On the other hand, if a company, such, for instance, as the British Electric Traction Co., worked the tramways in both towns, or even in one, it would be to its manifest advantage to build the lines which they could not otherwise touch.

The first of these light railways in England was the Blackpool and Fleetwood line: then the composite line from Stourbridge to the village of Kinver, and within the month, as chronicled in the REVIEW of October 10th, that part of the lines owned by the Tyneside Tramways and Tramroad Co., which joins Wallsend and Gosforth.

We look forward to the time, say, 10 years hence, when light railways (as used in a special and non-Parliamentary sense) mileage will make a good showing when compared with purely tramway mileage.

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The British were the pioneers in railroad construction and have taught the whole world, so that we may be quite sure the paper contains nothing which is new to our permanent way engineers, but a *résumé* may not come amiss to the readers of the REVIEW.

Much depends on the preliminary survey of the route, especially where the line is to run through private property, because it is difficult, when once rights of way have been secured, to make such revisions as subsequent developments may require.

Land must be bought, or rights of way secured, not only of sufficient width for the actual railway projected, with all allowance for drainage, banking and fencing, but in the case of a single line the width should be enough for a second pair of rails.

Unless the necessary land can be bought in advance, or by a third party, it is not well to treat for the worst land on the property with the idea of getting it cheap, for its value is raised to the level of the best directly the proprietor knows who wants it; and even where money can be saved in cheap land, this may entail additional construction and maintenance costs.

Bottom lands threaded by water courses should be avoided, for in such land many bridges may be required, and materials for embankments will be scarce.

In such construction it is possible, and certainly advisable, to avoid sharp curves, which not only tend to reduce running time, and to increase the liability to accidents, but result in shortened life of both rolling stock and permanent way.

Heavy grades should be avoided for the same reasons; and Mr. Hoff touches the spot when he says:—"It is much better to spend a little more money once to make the cuts a few feet deeper, and the banks a few feet higher, than to be constantly spending it for additional power to climb excessive grades; in general, simply because electric cars can be operated around sharper curves and over heavier grades than steam cars does not imply that these are desirable things to have in an electric railway."

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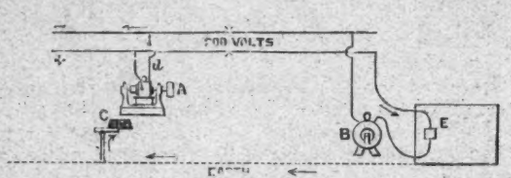

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Because American machine tools are not now selling so freely as they did, it does not signify that they have become worse. Many of them are better than they were, for while they certainly did serve to stir up a somnolent trade, they stirred up their own makers in addition. Few American tools have not proved deficient in stamina when set to work on harsher materials than their home cast-iron. There is, however, something to be learned from machine tools apparently made to do very light work. Why are they made to do such light work? As the general character of the American machine tool is towards lightness, we may infer that it does not have much to do. A light cut reduces the material on which it is working down to finished size. The material is not only soft, which is often a positive future disadvantage, but it is cast, if it be cast, very little above the finished size. Less surplus material is left to be removed. Patterns

are more nearly to size, and probably foundry work is better; this, by the way, being easier, because of the excellence of the material. A North Country foundry proprietor stated recently that he had some months ago purchased a very considerable quantity of American pig, and found it excellent material for certain purposes. It is quite probable that castings cannot be made so true with us as in America. At the same time it is certain that there is often far too much material left to be cut away. The habits of the pattern shop need quite a considerable reformation. Until pattern makers learn to work more closely than many castings lead us to suppose they do, it would be good policy not to finish and paint a pattern until it has been tried, and the cast product noted as to its various surplus parts. If found excessive in the machine shop, the pattern can be altered in accordance, so that all future work will be less costly to machine.

But it may be argued that the skin of a casting is very hard upon tools, and if too little be left to cut away, the tools are damaged. This may be admitted, but against this argument is to be placed a better one. There ought to be no skin of a hard and silicious nature on a casting when this goes into the machine shop. Some there are who tell us that their castings are cheaply and thoroughly cleaned of such skin by means of the sand blast. We have not seen the process in operation on castings, and do not know that it is, or is not, superior to pickling, as is claimed by its users. But pickling is cheap and efficient. It is done by wetting the castings thoroughly with a 10 per cent. solution of commercial sulphuric acid. The castings are kept wetted all day, being simply piled on a timber platform which stands over a drain tank, so that no waste of acid occurs.

As a rule, in 24 hours the whole sandy surface peels off, leaving a pure iron surface. The job is completed by a wash with water from a hose; the labour cost is small; the expense of acid is small; the total economy is considerable. In the first place, the castings are not cleaned in the ordinary method, because the presence of plenty of sand upon them serves as a sponge to hold the acid and helps the process. Secondly, all sand is removed by the pickling process, and none goes forward to the machine shop to render the place and the men dirty, and to get into the working parts of the machine tools to cut them away. Finally, the time spent in changing tools for grinding, and the grinding of them, is reduced, and the machine is doing work instead of standing still. All that requires to be done to a casting is to fettle it, and, except for gates and risers, which can be knocked off at once, other fettling can probably be done best after pickling. In steel foundries the difficulty of cutting the material tends, perforce, to the use of the emery fettling wheel on a flexible shaft. The same apparatus ought to be used for cast-iron; it would pay to use it on large pieces just as it pays to apply smaller pieces to the regular emery wheel on a fixed frame. There are founders who are alive to improved methods, but far too many foundries are backward, and a founder has no hesitation in feeling hurt if expected to turn out good sound stuff; whereas he ought to be ashamed to turn out castings appreciably wrong. The moulding boxes he employs are a disgrace. He thinks it a good excuse to talk about the boxes not coming together exactly, when he wants to explain a core ¼ in. out of place in an important piece. Why does he not so fit up his boxes that they cannot go together other than exactly? It is perfectly simple to do so, a mere question of drilling the lugs together that should suggest itself to the meanest intelligence.

If dirt is kept out of the machine shop it will be an all round help. An important feature of modern practice is warming and ventilation. A ventilated shop with low ceilings is better than an unventilated shop with lofty ceilings. Many shops are far too expensively built and proportioned. It is better to spend a little money on a combined heating and ventilating system than to spend too much on over-heavy and high buildings. All fresh air should be admitted above and allowed to escape at the floor level, and all necessary heat should be introduced with the ventilation, thereby saving the encumbrance of steam or hot-water pipes. It is a pity to record that some of the best and newest shops offer no greater inducements to the clean, tidy and sober workman than do the old-fashioned shops; yet much can be done in the way of civilising a workshop at a moderate expense.

Some of the German shops have, perhaps, carried out civilising methods at too great an expense; nevertheless they have aimed at the correct mark, and are to be commended. But there is a wide gap between extravagant expenditure and attempting nothing. That a modern shop should be entirely without inducements to the better class of workman is deplorable, and is bad policy into the bargain.

But one of the greatest errors in shop work, to return to the methods of carrying on work, is that which leaves the question of good or bad fit to the judgment of the workman, himself unaided except by standard gauges, or the worse error of attempting to manufacture in quantity on the old system of setting out each piece, instead of making it by the assistance of templates and jigs. In this respect it is perhaps as well to disabuse the minds of our readers. Though many of the best American works are thoroughly up to date, this is by no means universal, and the ordinary shops of America are by no means so advanced; there is a daily decreasing difference between the best American and the best English shops, their approximation being due to movement of each towards the other. We all know only too well that the boasted interchangeableness of American products is too frequently only a boast that does not bear investigation on the products as they arrive in this country. We may learn from actual facts that the quality of interchangeableness derives its name rather by contrast with former states of divergency, that it is a quality that needs watchfulness to maintain, and that it can only be secured by correct gauge systems.

Alluding to the works of the Birmingham Small Arms Co., a mechanic once remarked that their business consisted less in making things than in gauging them; the gauging staff being, to an outsider, of almost extravagant proportions. This merely illustrates what manufacturing amounts to. All the cost is in preparing to make things and in gauging them, to see that they have been properly made.

The machine work is simple after it has been prepared for.

W. H. B.

THE GLASGOW TRAM ACCIDENT.

The Board of Trade Report.

In view of the importance which attaches at present to the question of prevention of street car accidents, we think it worth while to print *in extenso* the B. of T. report on the recent disaster at Glasgow. The collision occurred on September 6th, and the circumstances subsequently formed the subject of an inquiry held by Major E. Druitt, R.E. He reported as follows:—

Railway Department, Board of Trade,
8, Richmond Terrace, Whitehall, London, S.W.
September 23rd, 1902.

Sir,—I have the honour to report, for the information of the Board of Trade, in compliance with your order of September 8th, the result of my inquiry into the causes of the collision between three passenger tramcars belonging to the Glasgow Corporation, which occurred on September 6th in Renfield Street, Glasgow.

The cars in question were all four-wheeled double-decked cars, fitted for electric traction on the overhead trolley system, and provided with the usual hand-brakes with blocks on all four wheels, and with an electric emergency brake. The conductor of the leading car, No. 690, which ran back down Renfield Street, was very seriously injured by the first collision, but I understand all the injuries to passengers, about 27 in number, were caused by jumping off, and that no complaints of injuries had up to the date of the inquiry been received from passengers who remained in the cars.

The accident occurred about 9·20 p.m., and the evening was fine.

Although Renfield Street is one of the steepest on the Glasgow Tramways system, the gradients are not severe ones for electric traction, the steepest being at the top of the street, where, for a distance of about 200 yds. it is 1 in 22. At the extreme top, where it joins Cowcaddens Street, the gradient is 1 in 36.

Below Sauchiehall Street, which joins Renfield Street at the bottom of the 1 in 22 gradient, the incline is 1 in 94 for 92 yds., and then becomes 1 in 24·6 for the remaining 280 yds. to St. Vincent Street, where the cars ran off at some points and came to a standstill. Thus the total distance the first car ran back was about 575 yds.

The sequence of events was as follows:—

R. Neeley, the driver of car No. 690 had gone up Renfield Street, and was just bringing his car to a stand at the authorised stopping place (at the top of the street before turning into Cowcaddens Street, where there is a junction with another tram line) by means of the hand brake, when the handle came off the brake spindle, and the car having first stopped began to run back down the incline of 1 in 22. Neeley states he at once applied the electric emergency brake, but that it had no effect on the car, which gained speed rapidly as it descended the incline. Just south of Sauchiehall Street, 230 yards from the top, another car was standing with hand brakes applied on the 1 in 94 gradient, but the impetus of the first car carried the second with it, and both went together down the street, and these two ran into a third car, No. 585, which was standing with hand brakes applied 180 yards behind the second car on the 1 in 24·6 gradient.

This checked the first two cars, and the three, locked together, ran back at a moderate speed another 165 yards to the junction of St. Vincent Street, where all three left the metals at the points and came to a stand, the third one running on to the pavement in St. Vincent Street and breaking a shop window.

The trolley of the first car remained on the trolley wire until the collision with the second car, when the trolleys of both cars came off the wire, and one of the poles, probably that of the second car, No. 755, carried away one trolley-wire span, and two guard-wire spans. When the guard wires fell on to the trolley wire there were some flashes, but no one was injured from this cause, as the power was automatically cut off by the circuit-breaker almost simultaneously with the first collision, the time recorded for this in the sub-station engineer's book being 9.21 p.m. Neeley, the driver of the first car, No. 670, states that when the car commenced to run back he did not think of applying the current, which would have stopped the car and taken it forward again, but that he tried to bring it up with the electric brake, and finding that had no effect, shouted to the conductor to apply the hand brakes at the rear end of the car. Campbell, the conductor, was unable to give evidence at the inquiry, but Neeley states that Campbell came through the car to him, but with the confusion does not know if he applied the brake or no. Campbell must have gone back to the rear platform, as he was injured by the collision with the second car, but he probably had no time to apply the brake before the collision occurred.

The accident was thus primarily due to the brake ratchet handle coming away from the spindle, owing to the locker pin having worked loose and come out. The pattern of handle is that known as the Brill brake handle, and the locker pin is of steel, $\frac{5}{16}$ in. in diameter, and is 1½ in. long, with a screwed head at one end ½ in. in length. It merely serves the purpose of preventing the brass

handle from being lifted vertically off the brake spindle, and no force is transmitted through it to the spindle.

After the accident, search was made for the pin on the car platform by Mr. Ferguson, the superintendent of rolling stock, and two others, but without success. A pin was found lying beside the car, No. 690, in the shed on the following day, but as all the locker-pins for this type of handle are interchangeable, it is impossible to say if it was the one belonging to that particular handle.

The car, No. 690, had been in use since 5 a.m., and I do not think the pin could have been out all day without being missed, or the handle coming off sooner, as although the brake could be worked by a handle without a locker-pin, still the first jerk would tend to dislodge it, and yet if it had come unscrewed by degrees, the driver should have noticed it, as it would have been projecting ½ in. out of the handle before it could come right out, as the screwed end is ½ in. in length.

I have never heard of a similar case, and cannot offer any explanation as to how it could have come out without being noticed.

Car No. 690 had been driven by two men during the day—viz., drivers Wyllie and Martin, and both state that the hand brakes were in good order during the time they were in charge. Wyllie further states that the electric brake acted very well when he took the car out the first thing in the morning. Martin states he had no occasion to use it. Neeley states that when he had the car in the morning the electric brake was not very powerful, but it was not sufficiently defective to cause him to report it or to tell the driver who took the car over from him, and when he took the car over a second time, at 7.45 p.m., he did not try it, and had no occasion to use it until the accident to the handle of the hand-brake occurred.

The electric brake was tried on the Monday morning by Mr. Ferguson, the superintendent of rolling stock, who found it working perfectly at low speeds.

I also asked Mr. Young, the manager of the Glasgow Tramways, to have some further trials made on the Renfield Street incline, and the report of Mr. Ferguson, superintendent of rolling stock, is as follows:—

REPORT.

As arranged, I brought two cars to Renfield Street between 12 midnight and 1 o'clock this morning, in order to test the electrical brakes on the gradient. Rain had fallen heavily during the evening, and the rails were consequently wet and fairly clean when the tests were carried out.

The two cars chosen for the tests were:—

Car No. 956, which is fitted with the Westinghouse equipment, and the Newell electro-magnetic track brake;

Car No. 691, which is fitted with the B.T.H. equipment and the ordinary electric brake.

The tests were chiefly carried out on the top portion of Renfield Street, between Cowcaddens and Sauchiehall Street, the full distance being 200 yards, and the gradient 1 in 22.

Car No. 956.—Starting at the top of the hill from the exact place from which car No. 690 commenced to run back on the night of Saturday, 6th inst., I carried out the following tests:—

The car was left free to run backwards with the trolley on the wire for a varying number of yards, and the Newell electric brake was then applied, with the following results:—

(1) 40 yards run.—Car brought to a stand in 37 ft., the speed being 8 miles per hour.

(2) 60 yards run.—Car brought to a stand in 45 ft., the speed being 12 miles per hour.

(3) 80 yards run.—Car brought to a stand in 50 ft., the speed being at least 15 miles per hour.

The same tests were afterwards carried out with the trolley off the wire, with similar results.

The next test was carried out with the car coasting down the hill in the usual way, at a speed of 6 miles per hour. The electric brakes, when applied, stopped the car in every case in the few feet.

Car No. 691.—This car, which was afterwards tested, is fitted with the B.T.H. equipment and the ordinary electric brake.

Car No. 691 is similar in every respect to Car No. 690. In testing the brakes of this car on the grade of 1 in 22, the trolley was taken off the wire, and the hand brake allowed to remain slack. The car was then allowed to run free backwards down the hill several times, each succeeding time for a greater length, so as to get up a higher speed. It was found that after running free for 40 yards, the speed attained was about 8 miles per hour, and on the application of the electric brake, the car was brought to a stand in 39 ft. On the second trial the car was run for 60 yards, the speed attained being about 12 miles per hour. On the application of the electric brake it was brought to a stand in 48 ft. On the third test the car was run 80 yards, the speed at that distance being about 15 miles per hour, and on the application of the electric brake it was brought to a stand in 60 ft. It was also found that, when the electric brake was kept full on after the car had been brought to a stand, with the trolley off the wire and the mechanical brake disabled, the car only moved a foot or two at a time—indeed, the motion of the car down the hill could scarcely be noticed.

After these tests were carried out, I tried braking the car when travelling forward, by reversing the reversing handle, throwing off the automatic cut-out, and applying the brake by putting the power handle to the highest notch on the power side. The result was that the car was brought to a stand in the same distance as before.

It will be seen from the above tests that if the electric brake of car No. 690 was in order at the time of the runback the driver would have had no difficulty in pulling up the car had he applied it. He states he did so in the proper manner, but I think it possible he may have omitted to reverse the power handle, in which case no braking effect would be produced on the car.

I think it is fairly well proved that the electric brake of car No. 690 was in order on the day of the runback, and as it was in order after the collisions, I think it must have been at the time of the runback.

The system of training the drivers before they take charge of cars appears to be thorough and satisfactory, and driver Neeley had been driving regularly for 18 months, yet I think the probability is that when he was suddenly confronted with an emergency he failed to use properly the brake especially provided for an emergency.

I do not blame him, as the evidence is not conclusive, but the probability is, I think, that he never applied the electric brake at all during the run-back.

It will be seen from the evidence of Inspector M'Nee that, when he looked at the car, 10 or 12 minutes after the collision, the controller and reversing handles were in such a position that no braking effect would take place on the car. Neeley at first declared that he left the handles in the same position as he had them during the run-back all the time until he removed from the car, but when Inspector M'Nee's evidence was read to him, said he might have shifted them after he came to a stand. From his replies to my questions, Neeley did not appear to have any definite idea as to the action of the electric brake.

Each driver and conductor in the Glasgow Corporation's employ is provided with a book of instructions as to how to act under various emergencies, and, as stated above, the training appears to be thorough before a man is allowed to take charge of a car, but it is also necessary for safety that the men employed as drivers should be intelligent and not given to excitement and "loss of head" on an emergency. Many men are fit to drive a car when everything goes without a hitch, and yet fail when an emergency arises, as in this case. If Neeley had at once applied the power when the car began to move backwards he would have at once stopped it and taken it forward again, but he states this never occurred to him.

The lesson to be learned from this is the necessity of having highly-trained and intelligent, level-headed men as drivers.

I may add that from the evidence of the general manager the inspection of the cars appears to be efficiently carried out, and that the drivers are instructed to take a car to a depôt should they have any doubts as to the reliability of its brakes.

Some correspondence appeared in the press as to the desirability of having a stopping place at the top of Renfield Street on a gradient of 1 in 22, but there is no difficulty in holding a car on such an incline.

It will be seen from Mr. Ferguson's report on the trials of brakes in Renfield Street that one of the cars, No. 956, was fitted with the Newell electro-magnetic track brake. I was informed by the general manager that it is intended to fit 100 cars on the Glasgow Corporation's system with these magnetic track brakes, and that these cars would be put to run on the routes with the steepest gradients.

This brake is, I believe, very powerful, but as I understand its efficiency depends on flexible connections being in good order, its superiority to a purely mechanical track brake has yet to be tested. I trust the Corporation will report as to its working in due course.

I have, &c.,

E. DRUITT, Major R.E.

The Assistant Secretary,
Railway Department, Board of Trade.

FERRANTI PATENT VOLTMETER RESISTANCE CUT-OUT.

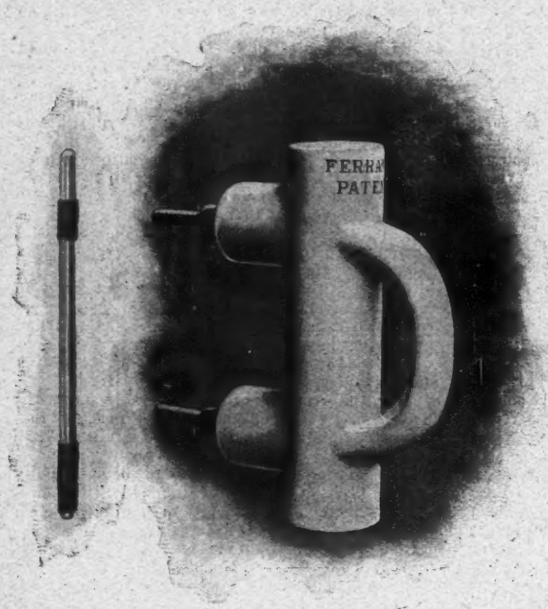
One of the chief difficulties met with in the use of high-pressure electrostatic voltmeters in central stations is the sparking across between the still and movable vanes. This is caused by a variety of things. In the first place, in order to get great sensibility, the moving and still parts are placed too near to give a large factor of safety. Transient rises in potential due to switching operations, are also a cause of trouble in this direction. Then, again, a voltmeter which in pure dry air would have a comparatively large factor of safety, under certain conditions will have its sparking voltage very much lowered due to dampness in the atmosphere, the presence of ozone as the result of silent discharges between the plates, &c.

Various protective devices have been proposed for use in this direction. It has been usual to place fuses and resistances in series with the voltmeter. The function of the resistance was to keep the current so small that the spark inside the voltmeter would not be sufficient to damage the instrument, while the fuse was to break the circuit when a spark occurred. Many difficulties were, however, encountered; for instance, it was very difficult to get a resistance of sufficiently high value to keep the current small enough not to do any harm, and a metal wire fuse cannot be made of sufficiently low fusing capacity to blow with this small current. If the current should continue to flow some time without blowing the fuse, the energy liberated in the resistance is so great as to make the latter very hot, and cases have occurred in which this has been broken and an arc has been started across the resistance terminals.

It has been proposed to use spark gaps in parallel with the voltmeter. The advantage of this method is extremely doubtful; in fact, it is highly probable that more harm than good results. It is an advantage under certain circumstances to have a choking coil in series with the voltmeter, and this is essential with overhead transmission lines, where these are subjected to atmospheric electrical

disturbances, but in England with underground cables they need only be applied where the switchgear is of bad design, resulting in transient rises in pressure. This is, of course, especially the case with flare switches used on high-pressure alternating current circuits; with a properly designed switchgear and underground cables, momentary rises of pressure are not to be feared.

Under these circumstances, the resistance cut-out made by Messrs. Ferranti, Ltd., is an efficient safeguard. It consists of a small glass tube, fig. 1, filled with water of a certain conductivity. A small valve is made in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing somewhat similar to the



Figs. 1 and 2.

rubber valve in a bicycle tire. The current is led in at the top and bottom of the glass tube by means of platinum wires fused into the sides of the tube. These are connected on the outside to brass terminals, and the whole is enclosed in an outer porcelain case, with plugs which fit into the terminals underneath the voltmeter (fig. 2). The whole device is shown in position on the switchboard in fig. 3.

Should a spark occur for any reason, such as a short inside the instrument, the water inside the glass tube will vaporise and force itself out through the valve, thus safely breaking the circuit.

The resistance of the water is extremely large; in fact, it is so adjusted as to be only low enough to allow sufficient current to flow

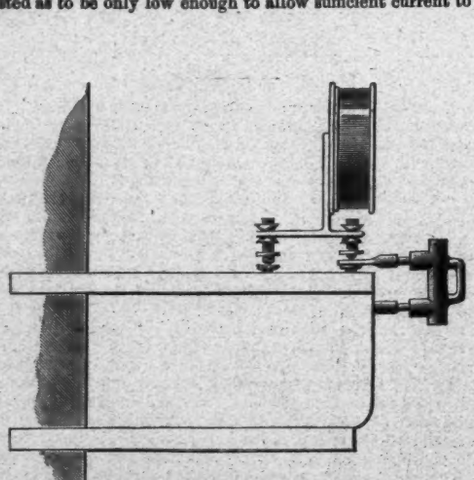


Fig. 3.

through to boil the water. Even if the water be of much less conductivity than this, no difference whatever is to be observed on the reading of the instrument.

This arrangement has been subjected to very severe tests, such as placing it directly across the terminals of a 3,000-volt alternator, when the circuit was broken so quietly that the tube had to be carefully examined to see whether it had blown or not. The device is now in successful operation in various extra-high pressure stations in this country.

CORRESPONDENCE.

Question of Trade Etiquette.

We note with interest a letter in your current issue by Mr. Wm. Cross, written on behalf of the Electrical Contractors' Association.

He does not seem to have quite grasped the facts of the case we referred to, namely, that we created our market for the fans, that we deliver them and fix them in place, and will have to maintain during 12 months, and all the wiring contractor will have to do will be to connect his wires to our terminals, and this, we presume, is included in his contract price. Therefore, we fail to see why he is entitled to such commission as Mr. Cross suggests.

Puzzled.

Students' Difficulties.

It seemed that all that there was to say about technical education had been said, and that the training of an engineer had been discussed until we were all sick of it. It has remained for "A Student" to write one of the most interesting articles that has appeared on the subject, to remind us, or rather to make the discovery, that all the talking has been on one side, and in writing, to introduce more of the human element than is often to be found in technical literature; for his clearly expressed difficulties appeal to the fellow-feeling of engineers and the sympathy of teachers.

"A Student" is bewildered: he asks what is the good of learning this, and why am I not taught that? Nine-tenths of his difficulties arise from the confusion (as disclosed in his articles) of the teaching of sciences with the teaching of trades. I do not believe that craftmanship can be learned or taught thoroughly in a technical college: it must be learned during apprenticeship at works. I make a distinction between learning and teaching, for at many works there is no teaching, but at all there is opportunity to learn. Why can the seven-year apprenticeship of 30 years ago, the three-year apprenticeship of 20 years ago, be reduced to two, or in limited cases of specialisation to one year? Because the underlying scientific principles may now be learned at technical institutions. Of what use then are the workshops and laboratories of the colleges and schools? To give opportunity of observing practical examples of the application of the sciences.

"He knows well enough that when he is learning how to draw a sine curve, or (in his practical work) how to clean wires and joint a cable, that in all probability he will never have to do this again in his life." "A Student" gives in these words excellent examples, and clearly explains one of his difficulties. Unless the true nature of the teaching is explained to him, he will find the same difficulty when he goes, after college, through the works.

It is true that 80 engineers out of 100 never have to draw sine curves. But about 50 engineers out of 100 occasionally come across sine curves, or, to put it more broadly, the dealing with or expressions of harmonic motion, and if they have once familiarised themselves with sine curves and their properties, the repulsive language of mathematicians will have lost more than half its terrors. All that concerns engineers about curves is their properties. The second example—how to joint a cable, is of a totally different character. In the first place, I hold that the workshop of a technical college is not the place to be taught or to learn how to joint a cable. That art should be learned during apprenticeship. Of what use then is the jointing of cables in colleges and schools? As an example of the scientific principles which underlie it. A student who has received a good technical training will be able to learn how to joint a cable, and to do it pretty well, in a day, while an equally intelligent man, having no scientific knowledge, would not know as much about it after a month of such work. The

student's knowledge of chemistry enables him to grasp the presence of oxides on the wires, the use of fluxes in removing them, the proper fluxes to use in different cases, their advantages and disadvantages. His knowledge of metallurgy has prepared him for the use of alloys; he will recognise what tinning means, the constituents of solder and its properties when melted or half melted. In physics he has been acquainted with conduction of heat, and sees why, in some cases, a blowpipe may be used, and his acquaintance with capacity for heat shows him why a soldering iron is sufficient for one job while a ladle full of solder is better for another. His elementary knowledge of surface tension and capillarity explains the tricky behaviour of melted resin and solder, and enables him to see the full force of the great secret of soldering and sweating. In a technical college all these principles are taught, and they are also taught in other places as pure chemistry or physics. The professor of pure physics would not dream of taking a soldered joint as an example of capacity for heat or surface tension. One of the distinctive features of the teaching of science in a technical college should be the selection of technical examples which lie around in profusion, instead of purely imaginary and some rather ridiculous examples of the text books.

But why should a student learn how to make a joint either at college or in the works? "A Student" thinks that "in all probability he will never have to do this thing again in his life." He fails to see the point; it is not his fault, he might not have guessed it, but he should have been taught it. The point is that he will very probably be responsible for the proper jointing of cables by men under him. He must, therefore, be a judge of a sound joint. It would be possible, but difficult, unless after long experience, to judge of a specimen of soldering unless he had at all events tried to do such work. It is by no means necessary that he should be able to turn out a first-class job. Again, the work under his supervision may be done badly. The bell-hanger and even the carpenter sometimes turns into a wireman, and once a wireman and a man of courage he would not refuse to try to joint a triple concentric feeder, unless indeed he were too courageous. How will "A Student" be able to criticise bad work, to point out the faults, perhaps to explain why they occurred, and not improbably to teach the ex-bellhanger how to do the work, unless he has learned to do something like it himself? The whole object of apprenticeship is to learn to know how work ought to be done: the whole object of technical education is to enable that learning to be acquired intelligently and not in Chinese fashion.

You, Sirs, have touched in your article on p. 606 on the question of dynamo designing. It would be interesting to know how many men in this country are actually engaged in dynamo design; or the proportion of all the electrical engineers in the world who are so engaged. Excluding the lower grades of draughtsmen who are only paid to draw, and for whom it would be a presumption to think in office hours, would not 2 per cent. be too high? You very pertinently remark that no one wants newly-fledged dynamo designers. And how much time is spent on dynamo design in lecture rooms? I believe a good deal; perhaps rather too much. It is a tempting subject for the teacher—almost illimitable. But if at the most, say, 5 per cent. of the students in after life will have to design dynamos, of wha use then is all this teaching? An engineer will be much better able to criticise, to be responsible for, and perhaps to superintend the repair of a dynamo if he has a general acquaintance with the principles on which it is built.

The student should not be discouraged by $dx\ dy$; it is only a clumsy way of expressing how things work. They do not really work like that, but mathematicians employ unfortunate language, and this difficulty cannot be avoided for the present. The worse tangle the mathematician gets into, the more plainly he confesses the poverty of his mode of expressing his ideas. The student may be sorry for the teacher and for himself, but he must not despise mathematics. No mathematician in the world could describe all that happens at an ordinary mill sluice, but an average engineer can make himself master of all that is necessary to know about it. It is an immense comfort to reflect that no one has calculated the force of the blow of a hammer with any pretensions to accuracy.

"A Student" deserves more help than I can give him. Most of his difficulties may be explained satisfactorily, and some remain as telling criticisms of his teachers. If his ability to write an interesting article is an indication of his technical training, it speaks well for him and for his college.

Alex. P. Trotter.

It was with considerable interest that I read the contribution to your valuable journal by "A Student" on "The Difficulties that Students of Electrical Engineering meet with." I quite agree with the majority of his remarks, especially the one where he states there is a want of combination of theory and practice, but his idea of the remedy does not meet with my approval. Personally, I believe the practice of sending sons to college before works is bad; it is possible to learn practice *without* theory, as is proved by the excellence of the work turned out by the average British workman, but it is absolutely impossible for 99 per cent. of the students to learn theory properly without practice; they do not seem able to really grasp it, and the consequence is that because it has failed to make any great impression on their minds, they are unable to apply it to practice, and they soon forget what they have learnt. As manager of a large firm of engineers, I am, naturally, asked by parents who intend making their sons engineers, whether they ought to send them to a college, and I always say "No, send him through some good works for a few years, and after that time, if he has a strong inclination to go to college, send him to one; but whether he goes to college or not, he must study hard during his spare time while at the works." I firmly believe that many men would be better engineers if they had reversed their order of training. At the same time it is not necessary in nine cases out of 10 for an engineer to receive a college training, as the man who will not stick to study in his spare time before going to college, will not do himself any good by going to college, but, on the contrary will come away with so much time lost.

Reader.

P.S.—Although your correspondent implies that he is a student I am not inclined to believe it, as there are several passages in his article that give me the impression that he is rather beyond a student; but, of course, I may be wrong in my surmise, in which case he is one who need have no fear of his future.

Tramcar Brakes.

The subject of efficient "Tramcar Brakes" has been forced to the attention of tramway engineers and corporations, owing to the great number of accidents which have recently occurred, due to lack of foresight on the part of tramway engineers and others, who were too slow to take heed of good advice and warning, as to what would be the consequences of not having tramcars properly equipped with that most important appliance (an efficient emergency brake). If tramway engineers, general managers of tramways, and up-to-date Corporations will peruse my article (viz., "Corporation Tramways and Emergency Brakes," in the issue of this paper of March 28th, this year, pages 504 and 505), they will on reading it, come to the conclusion that there was at least one individual who had an eye on the future, and who was sufficiently up-to-date to foresee the disastrous results of not adopting an "Efficient Emergency Brake."

In my first paragraph of that letter I predicted what would (and did) surely happen; since that letter appeared over six months ago, there has occurred a number of very serious and fatal accidents.

I may here state once more that I have tested dozens of brakes both in the United States and this country (covering over five years technical and tramway engineering experience, &c.), and have found that only one brake approaches the "ideal," and that is the Pneumatic Slipper Brake, of Messrs. Hewitt & Rhodes; its great advantages I set forth in the issue of March 28th, 1902. I claim credit for (over six months ago) advising all persons interested in tramways, also the Board of Trade what to do. It is about time that the Board of Trade took stringent measures to prevent accidents with their serious consequences (no matter whatever the cost of equipment).

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The brake of Messrs. Hewitt & Rhodes is instantaneous in its action, and brings a car going at a speed of 10 to 15 miles an hour and upwards, to rest in the space of a comparatively few feet. Prevention is better than cure, and once again I warn tramway officials and others to equip their cars with a good, reliable, and efficient emergency brake. The time will come when they will have to do so, and it is the best policy to invest the capital now on brakes (which is a cheap investment) rather than be forced to adopt them after some serious accident has happened, in which they will have to pay both for brakes and damages as well. I think the Board of Trade have been very slow indeed in not having given this all-important subject thorough investigation long before this chapter of accidents had occurred. Some of the so-called "emergency brakes" are not worth the name of brake, and are only death traps. It might not be a waste of time for farsighted Corporation Committees to also peruse my article on "Tramway Management and Finance," issue of ELECTRICAL REVIEW of April 11th, 1902, pages 587 and 588.

Wm. R. Bowker,
Lecturer on Physics and Electrical Engineering,
Physics Laboratory,
Municipal Technical School, Halifax.

The recent articles and correspondence in the ELECTRICAL REVIEW on the above subject seem to me to entirely overlook the existence of a magnetic track brake, and the advantages to be gained by its use.

The brake I refer to consists of a double track shoe, wound as an electro-magnet, which, when energised by current, produced by the car motors acting as generators, is attracted to and grips the rail by magnetic force, the resultant drag and downward pull actuating a system of levers which apply ordinary shoes to the car wheels. This has a combined braking effect, greatly in excess of any known form of hand or power brake yet devised for cars, consisting of four distinct braking effects as follows:—

1. The retardation caused by a positive and constant load on the motors whilst acting as generators.

2. The retardation caused by the friction of the track shoes and the rails.

3. The maximum retardation possible of the car wheels, caused by the drag of the track shoes acting through levers on the wheel brake shoes.

4. An increased downward pressure of the wheels caused by the downward pull of the magnets.

The ordinary slipper brake, worked whether by hand or power, is well known to be entirely wrong in principle, for if it were carried to its extreme limits, the car would become entirely borne by the track shoes in contact with the rails, an effect which is obviously far less efficient than a brake which acts on the wheels without causing them to skid, and which actually helps them to obtain a greater hold of the rail.

As an emergency brake, nothing could excel it, as the greater the speed of the car, the more effective the action of the brake. The brake can also be applied to its maximum power, whatever the condition of the rail, as should the rail be dry and sandy, the drag of the shoes is at its greatest; when the rail is greasy, the drag is consequently slightly less, and the wheels are retarded with a slightly less effect; in both cases it being impossible for the wheels to skid. When it comes to a question of operation the case is very simple, the driver has not a multiplicity of wheels or levers in front of him to confuse him, as in the case of ordinary slipper brakes, the magnetic brake being applicable to any controller that has braking points; the main controller handle is simply continued in its backward motion from full on to off, on to the several braking points, an operation requiring one motion, and some two seconds at most to perform, the car being brought to a stop in less time than it takes to apply the slipper brake. It is scarcely possible for it to fail in action, as owing to its simplicity of operation, it is a good brake to use for service stops; it being so used makes it always ready for use in descending an incline, or in case of emergency. There is also no strain on the motors being used in connection with it, as the current required to energise the magnets in descending an incline 1 in 13 at four or five miles per hour is only 10 amperes.

Another feature is its adaptability to bogie cars, this class of car being left entirely alone by inventors of mechanical track brakes, whereas the magnetic track brake can be fitted to either single, maximum traction or equal wheel trucks.

I give below four examples of what can be done as emergency stops with the magnetic track brake with both a single truck car having two motors and a bogie car having four motors.

Running speed, miles per hour.	Distance travelled from commencem't of switching off from full power to dead stop.	Time taken to stop.	Type of car.	Track.	Condition of track.
15 m.p.h.	24 yards	4½ sec.	Truck	Level.	Dry
20 m.p.h.	45 yards	7½ sec.	Truck	1 in 13½, down grade.	Dry
13 m.p.h.	32 yards	4½ sec.	Bogie, four motors.	Level.	Dry
22 m.p.h.	55 yards	6½ sec.	Bogie, four motors.	1 in 13½, down grade.	Dry

G. R. W. Roberts.

Newcastle-on-Tyne.

Having had considerable experience in a city with several gradients of 1 in 10, and many between that grade and 1 in 15, I should like to express my perfect satisfaction with the hand-applied type of track brake. About 200 cars are equipped with three brakes, viz., wheel brake (ordinary hand brake), rheostat electric brake, and a track brake. The practice is to apply the track brake at the brow of any hill steeper than 1 in 13, so that the car is considerably retarded, and to adjust the speed by means of the rheostat electric brake. In the event of the electric brake failing, the wheel brake may be used in conjunction with the track brake with equal effect, although greater exertion is required on the part of the driver, and there is greater liability to skid the wheels. In the event of the latter contingency, it only requires another half turn of the track-brake handle to bring the car to "dead slow."

In regard to the power of the unaided track brake, I have brought a 9-ton car to a standstill in 60 yards on a grade varying from 1 in 10 to 1 in 12 after obtaining a speed of 18 miles per hour. The wood blocks have a bearing surface of 18 in. × 2 in. They are of poplar wood, with eight holes drilled in the bearing side. Alternate holes are plugged with oak plugs and a mixture of resin and sand.

Although the system of which I write has been operated electrically for two years, and has a route mileage of over 25 miles, it still preserves a clean sheet as far as runaway accidents are concerned. This is mainly due, I believe, to the intelligent use of the hand-applied track brake by well-trained drivers.

Assistant Manager.

October 18th, 1902.

As I am a tramcar driver and have had experience with several classes of brakes, I thought it might be interesting to your readers to give my experiences.

To drive an electric car, we will say from 8 to 10 hours per day, and to use the handbrake only, I find it takes a man of unusual strength to finish his day's work, and not feel fatigued afterwards; sometimes we have to work overtime. It is then that we drivers feel done up, especially if the rail has been skiddy, which gives us twice the amount of work required on a fine day. We can hardly walk home, we feel that tired out.

We have so many operations to perform at the same time, when the risk of an accident occurs, and we are so stiff and cramped by only using our ratchet brake continually, that the accident occurs before we know where we are.

The thing I cannot understand at the present day is that we have discarded brute force (viz., horse cars), and yet the

driver is left with the old-fashioned brake that was quite suitable for the horse trams.

Why can't someone bring out a patent that will connect the handbrake and air slipper brake together, thus making the work of the driver ever so much easier, with twice the control over the car that he has at the present time.

I have used the air slipper brake several times during the time I have worked on an electric car, and I find, and can honestly say, that it has saved me many an accident that would have occurred if I had not had one on my car, as the handbrake on some occasions will not act properly when you are placed in a difficult position.

And if the air brake was connected in some way to the handbrake, it would be twice as easy to stop a car, and also give the driver more control over an electric car. The driver then would be able to stop his car at any time, thus making the public confident in trusting themselves altogether to the driver.

I wish we could have a wheelbrake put on by air pressure and attached to the air-slipper brake, as it would lighten the duties of the driver so that he would be able to stop his car, and feel confident of doing so at the same time. If the air brake was so arranged as to be brought into operation with the wheel brake, and on turning the handle further round the slipper brake was brought into operation, we should then have the very best combination to avoid accidents, and certainly very much easier duties for the drivers, and more control over the car.

As this is not only my opinion, but the universal opinion among tram drivers, we are pleased that the brake question is likely to be fully inquired into by people having the power in tramway matters. Other drivers may also write, offering better opinions, no doubt.

Driver.

Mr. Ogden disagrees with me in recommending a use for the Spencer type of brake because a more recent type exists.

I saw the first Spencer brake that was made tested at Bradford in 1898 on a gradient about 1 in 14. The Corporation had shortly before made very severe tests on other brakes at the same place. I also tested the same make of brake at Norwich two years afterwards, and was unable to stop the car altogether even on a slight gradient.

The ordinary handbrake, regularly inspected and adjusted, is, I consider, the best brake for general use. It has, however, a limited factor of safety for any strain that is thrown on it, and by using it on steep gradients, as 1 in 11, we are reducing the factor of safety at a time when we require it most.

By using the slipper as I suggest, less strain is thrown on the hand-brake, and the slipper brake is in a position for immediate application if it is required to apply it more strongly.

I quite allow that a competent driver (no others should ever handle a car carrying passengers on a bad hill) can descend a hill using the hand-brake alone. But have not many bad accidents occurred from his being unable to do so on one occasion?

As hills requiring the track brake do not form the whole of any system, and as the slipper only requires to be moderately applied, the wear would not be so very great.

In my article, wishing it to be as short as possible, I only described a controller without rheostatic brake, although I afterwards spoke of the electric brake, meaning a rheostatic brake. Of course with a controller fitted with rheostatic brake, the emergency electric brake is applied with the left hand with the same movement that cuts off power.

H. B. Phillimore.

Notes on the Practical Working of Rotary Converters.

The able article by Mr. Salter upon the above subject, which appeared in your issue of October 17th, is of special interest at the present time, when the economical handling of the "conversion" side of a polyphase and direct current combined system is of such importance. There is, perhaps, rather a tendency with many engineers to "funk" the use of the rotary converter, and to plump straight away for the less exacting, though less efficient motor-generator. When, however, a machine is required for flexibility of conversion on either side of the system, it is a question whether the synchronous motor-generator is not more suited for the work. Take the case under consideration in the article. For satisfactory working when being driven from the direct current side, in order to overcome the demagnetising effect of the alternating side upon the common field, the rotary has to be separately excited. The method employed for accomplishing this with a small motor-generator, which automatically varies the field strength, is certainly very ingenious, and no doubt works very well, but it means an extra running unit, and constitutes another item of expense in the equipment. Then again, the conversion to alternating current having been made, there are the step-up transformers at the station to be reckoned before transmission to the sub-station is possible, these latter being necessary also to step down the high tension generator pressure for driving the rotary at the station from the usual, or alternating side.

Suppose, now, that a synchronous motor-generator had been used, with the alternator side working at the same high tension pressure as the station generator. In the first place, the transformers at the station would have been dispensed with. Then, as there would be no common field to be demagnetised, the separate exciting set would not be required. The exciting current for the alternator field could be furnished from the direct current side of the machine itself, and the set would then be quite independent. Moreover, when running as a direct-current generator, it would not have the same tendency to take more than its share of the load that a rotary has when in parallel with the low-tension bus-bars. The system, mentioned in the article, of lighting the sub-stations by alternating current shows what can be done in that way successfully, and even with such a low periodicity as is used for tramway work.

Douglas Kelleway.

Electricity Works, Folkestone.

Mechanical Engineers for Electric Generating Stations.

When I wrote my first letter to you advocating the employment of mechanical engineers as shift engineers in central stations, I did so hoping that experienced central station engineers would favour us by giving their opinions on the subject, but so far only shift station attendants have done so.

One of the latest to "enter the arena" is "A.I.E.E.," with only three years' experience, who states in the opening paragraph of his letter that he is unable to follow the arguments. The remainder of his letter fully supports the statement.

My contention is that properly qualified mechanical engineers with electrical experience should be the only ones allowed to take responsible charge of the shifts, as the majority of the present so-called shift engineers are incompetent.

An ordinary unbiassed mind will see at once that the latter are not fitted by training or experience to have the superintendence of valuable boilers, engines, &c.

Let us look at a typical so-called shift engineer. He is generally a young man, who, having had one or two years as a junior in a station, is appointed to take charge of a shift at wages from 20s. to 25s. per week.

At the station are engine drivers and stokers who have had perhaps 20 years' experience, and whose wages are from 10s. to 15s. per week more than his.

Now, Sir, I ask is it common sense to say that this shift engineer has real charge of the running of the plant? I reply it is absurd on the face of it, as he is quite in the hands of the workmen, depending entirely on their experience. If the men are incompetent also, Heaven help that station!

Now, this glorified labourer (for he is neither a mechanical or electrical engineer, nor can he claim to be a switchboard attendant, engine driver or stoker) who tries to cover his want of practical knowledge with a very thin veneer of technical knowledge, labours under a misapprehension if he thinks that he really has charge of the shift.

No chief engineer would for a moment leave the station in

charge of such an one, if the efficient running of the plant depended upon his knowledge and experience.

It is, as a friend of mine said:—"We chief engineers must have someone to *nominally* take charge of the shifts. We cannot afford to pay the wages of a qualified engineer, so we are compelled to *put up with* these others. We can, however, as a rule, depend upon the other workmen on the shifts." I cannot help thinking that this is a deplorable state for a station to be in, and it is the state of hundreds of stations. I maintain that it is against the best interests of the undertaking to employ such men as I have described, to take charge of the shifts.

In the station in which "A.I.E.E." has been employed, they seem to have run the plant in a very loose manner, for their figures had to tell them something was wrong, then they routed out the cause. Routed out the cause! What a groping in the dark that expression suggests! Now with a regular system of tests, faults are discovered and localised, thus saving the blind routing-out process.

Although your correspondent says he is "an assistant to a consulting engineer with over 30 stations under his control," I do not accept that as evidence that *he* is an engineer, or that *he* is possessed of much practical knowledge or experience.

"A Shift Engineer" commences his letter with a most inapt comparison, and then goes on to say that my experience is narrow. I can only say that, as I have had probably at least five times the number of years' experience that he has, other things being equal, his experience is narrower than mine in that proportion. The statement I made that the shift engineer is not allowed to handle the engines is quite correct; your correspondent's addition:—"And the engines are not allowed to handle the shift engineers" is trifling and stupid.

There are at least two reasons why the shift engineer is not allowed to handle the engines:—

1. Because the engine drivers are engaged for that purpose.

2. Because not 1 in 20 so-called shift engineers is capable of properly doing so.

I have replied to the "logical outcome" portion of your correspondent's letter above. To "F. R.C. R." I commend the first paragraph of "A Shift Engineer's" letter. As I do not propose writing you again on the above subject, may I say that I quite agree with "A University Lecturer" when he states, in his article on "The Difficulties that Lecturers on Electrical Engineering meet with," that there is "a crying demand for the immediate action of either the Institution or the Board of Trade to make some sort of official certificate compulsory for the would-be electrical engineer." What a wholesale scrapping of so-called shift engineers there would be if a certificate of competency were compulsory!

Albert E. Vezey, A.M.I.M.E.

BUSINESS NOTES.

Reported Battery Combine.—There is an American report in the press to the effect that an international combination has been formed in the storage battery business which, for all practical purposes, will control the patents and the manufacture of storage batteries in the United States, England and the Continent.

Electrical Trades Union.—The first meeting of the session of the Leicester branch of the Electrical Trades Union was held on Friday evening, and took the form of a concert. The programme for this winter's session includes lectures on special systems of wiring, transformers, electric glow lamps, instruments, repairs, and electric tramways.

Foreign Electrical Imports.—The Board of Trade returns for September last show that the imports of foreign electrical goods and apparatus into this country attained a value during the past month of £47,588, as compared with £57,388 in August last and £46,651 in September, 1901. So far as the year has gone, there has been a noticeable shrinkage in these imports, the total for the nine months ending with September last having amounted to only £514,255, which compares with £683,820 in the corresponding period of last year and £794,699 in the first nine months of 1900.

Electrical Wares Exported.

Week ending Oct 22nd, 1901.		Week ending Oct. 21st, 1902.	
Alexandria. Teleg. mat.	Value £123	Aden	Value £655
Amsterdam	105	Alexandria	143
Bangkok	90	Amsterdam	133
Bombay	472	Auckland	48
Calcutta	1,470	Bombay	269
,, Teleg. cable ..	197	Buenos Ayres	79
Cape Town	152	Calcutta	363
,, Teleg. sundries ..	106	,, Teleg. wire ..	665
Colombo	263	Cape Town	629
Copenhagen. Teleg. wire ..	248	Coatzacoalcos. Teleg. apparatus	35
Durban	359	Colombo	130
Flushing	13	Copenhagen. Teleg. cable ..	129
Fremantle	16	Demerara	50
Gothenburg. Teleg. wire ..	44	Durban	146
Hamburg	11	East London	284
Hong Kong	750	Fremantle	386
Melbourne	48	,, Teleg. mat.	90
Nagasaki	1,560	Halifax	47
Penang. Teleg. mat.	58	,, Teleg. mat.	79
Port Chalmers	720	Hong Kong	1,089
Rotterdam. Teleg. wire ..	26	Kobe	122
Shanghai	137	Madras	10
Stockholm. Teleg. cable ..	914	Malta	80
,, Teleg. wire ..	60	Melbourne	99
Sydney	569	New York	7
Yokohama	2,162	Otago	48
		Perth	783
		Port Elizabeth	541
		Riga	20
		Rio de Janeiro	18
		,, Teleg. mat. ..	75
		Rosario	45
		Rotterdam. Teleg. mat. ..	180
		St. Petersburg. Teleg. mat. ..	300
		,, Teleg. wire ..	804
		Shanghai	87
		Singapore	59
		Sydney	469
		Vigo. Teleg. apparatus ..	750
		Wellington	56
		Yokohama	323
		Zanzibar. Teleg. mat.	60
Total ..	£10,668	Total ..	£10,196

Foreign Goods Transhipped.

Gothenburg. Elec. appa.	Value £30

Dowsing Circular Radiators.—The Dowsing Radiant Heat Co. are bringing out a number of new types of their patent luminous electric radiators, and amongst others, a circular type suitable for placing in the centre of a room. In addition to the ordinary system of heating by means of powerful radiators, the top of this radiator is made removable, so that a dish containing food can be warmed from the heated and ascending air. A portion also

of the heat radiated from the lamps is thrown on the dish. The company claim that their special form of reflector, which reflects heat rays away from the lamps, and diffuses them, and at the same time forms a chamber for heated air, is quite successful in heating and cooking apparatus, as is shown by the electrical roaster now in use at the Brighton Electrical Exhibition. The illustration above shows the new type of circular radiator, which is handsomely finished.

Destructor Plants.—The Horsfall Destructor Co., Ltd., have, within the past few weeks, received orders from the Bradford Corporation for a destructor plant to deal with 120 tons per day; from the Corporation of Swansea for a plant to deal with 75 tons per day; and from the Corporation of West Hartlepool for a plant to deal with 60 tons per day. The last-named plant is an extension of the existing "Horsfall" destructor, which has given very satisfactory results.

New Stoneware Conduits. — The Ames Crosta Sanitary Engineering Co., of City Chambers, South Parade, Nottingham, have placed before us a coloured show list of their patent stoneware conduits for electric cables. The Ames conduits are circular in section, externally similar to an ordinary pipe, with the interior divided by partitions into any required number of cable ways; a suitable space is left at the invert for a waterway to drain away any water or moisture that may find its

Section Through Joint.

way into the conduit, and a sufficient distance is allowed between the partitions at the joints to permit of any leakage falling to the invert, so that the cable ways may be kept perfectly dry. By means of the patent self-centring joint a true invert and perfect continuity of the partitions and ways are ensured. The joint can be made with clay or cement, the same as for ordinary drain pipes, or a "Stanford" or patent joint may be used. The makers supply bell mouths or other special forms for draw boxes.

Motor Contract.—The Electric Construction Co., Ltd., has been successful in securing the order for 59 motors for the small-arms factory at Ishapur, for which a specification was recently issued by his Majesty's Government.

N.B. Station Hotel, Edinburgh.—An important installation of electric light, inter-communication telephones, bells and telephones from sitting-rooms and bedrooms, fire alarms, heating, power, and ventilating circuits, has been carried out at this hotel by Messrs. Jas. Gray & Son, of 85, George Street, Edinburgh. An idea of the magnitude of the installation may be gained from the following details:—The switchboards have four separate supplies for lighting from the Corporation mains, at 230 volts pressure, and two separate supplies for power at 460 volts pressure. There are over 20 fans and blowers in the building, and eight elevators, all worked by electric power. The weight of the main cable between the Corporation supply (which passes the front of the building) and the main switchboard in the basement is over 4 tons. Over 100 miles of cable and wire have been used in the building, representing something like 20 tons of copper. The main and sub-main cables are concentric, lead-covered and steel armoured, and all branch wires are enclosed in screwed malleable iron tube, the length of which is over 60 miles. There are over 5,000 incandescent lamps used on the installation, which is one of the largest which has been installed in any building in Britain. It is not surprising to learn that it has taken fully three years to execute the work.

New Magazine.—We have received an advance copy of the first number of the *Magazine of Commerce*, a shilling illustrated monthly for men of affairs. It is published by the *Magazine of Commerce*, Ltd., of 72, Coleman Street, E.C., and contains a remarkable quantity of interesting and instructive matter relating to home and foreign industry and commercial questions generally. There are some first class plates and numerous photographs of industrial leaders. If it maintains the standard set up in its first number it should have "a good run."

Correction.—In our article on "Continental Electrical Industry" last week, in the reference to the Telephone (Berliner) Works Co., of Hanover, it was stated that "this unsatisfactory position . . . . is due . . . . partly to direct losses incurred by the foreign branch." This should read *a* foreign branch, as there are several of them. It, of course, does not refer to the British branch of the company.

Bankruptcy Proceedings. — At Derby Bankruptcy Court on October 14th, David Roberts, electrical engineer, of Normanton Road, Derby, appeared for his adjourned public examination. The Official Receiver stated that it had come to his knowledge since the previous examination that the debtor had a patent which he had not disclosed, and the bankrupt replied that he had an interest in a patent a long time ago, but it was only conditional, and he lost it because he could not fulfil the conditions. It was a steam turbine, and it was taken out in the joint names of Mr. Whitcher and himself. He (the debtor) made models of the turbine, which were not satisfactory, and as he could not fulfil the conditions of the agreement, he lost it. He was not aware that his father-in-law had offered money for this patent; he was surprised if he had, because it was of no value to him. Debtor added that he had disclosed all his other assets, and that he had lost his interest in the turbine because the time had expired according to the agreement. The examination was closed.

Combination Wall and Table Telephone.—We recently drew attention to a novel form of electric light fitting, the *raison d'être* of which was the practical convenience and commercial value of a device which can be made to serve many purposes, so that a trader can carry a small stock, and yet be able to meet a large range of requirements. Precisely the same reasons have led to the

Fig. 1.

evolution of the simple combination telephone set which is illustrated herewith. In one view (fig. 1) the apparatus constitutes a very neat wall telephone station, complete with buzzer, call button, and speaking key. The case is hinged, so that it can readily be

Fig. 2.

swung open for inspection of the interior, and the holes for the leads are all ready drilled in the back. With the aid of a screwdriver, the addition of a single small metal part (a pillar), and the expenditure of less than one minute in time, the set is converted into the handsome table set shown in fig. 2. Comment is needless. The set was devised, and is being placed on the market, by the Berliner Telephone Manufacturing Co., of 117, Queen Victoria Street, E.C.

Fire Alarm Test.—A working test of the May-Oatway automatic fire alarm was recently carried out at Messrs. Hunter, Barr & Co.'s new warehouse in Queen Street, Glasgow. The test was perfectly successful, the first alarm being given in 20 seconds from the time of lighting the fire, and the first detachment of the Fire Brigade arriving in 2 min. 50 sec. from the signal.

Catalogues and Lists.—An illustrated *brochure* has just been issued by the Westinghouse Brake Co. descriptive of a type of buffer-coupling which has been in use now for some years on a number of vehicles in America and Canada. It is made in two forms, one to transmit both pulls and pushes—the American practice—the other for use with side buffers on the ordinary European system, to transmit pulls only. The special feature of the gear is the utilisation of frictional resistances to dissipate the force of heavy shocks, instead of storing the force to cause an equal recoil. How well this result has been attained may be judged from the fact that, while it takes a force of 140,000 lbs. to fully compress the push-and-pull type gear, the reactive effort is less than 6,000 lbs. The friction apparatus consists of eight V-shaped iron bars, working in grooves on the inner surface of the cylinder which contains the mechanism; only fairly heavy shocks affect this part of the apparatus, the springs having to be first compressed to a definite extent. Thus the wear of the friction bars is greatly decreased. The gear can be fitted to any type of railway wagon. The difficulties of starting heavy trains without injury to ordinary draft gear are said to be overcome with the friction draft gear.

Messrs. David Brown & Sons, of East Parade, Huddersfield, have sent us a pamphlet describing and very neatly illustrating

their "Chicago" rawhide gearing. These pinions are very largely used by engineering firms, chiefly on electric motors. The British "Chicago Rawhide" Manufacturing Co. have ceased making rawhide gear wheels, finished rawhide blanks, other and gears, and have transferred this branch of their business to Messrs. Brown.

A new and revised catalogue of cheap electric gauges and testing sets has been issued by Messrs. Eversheд & Vignoles, Ltd., of 110, Cannon Street, E.C. The Eversheд patent testing sets (1900 pattern) are described and priced in a separate circular.

A pamphlet and list received from the Twin Tube Engineering Co., of 47, Hatton Garden, E.C., describes the "Gleaner," a feed water-heater designed to utilise to the utmost the heat contained in exhaust or live steam for heating water. The essence of the apparatus lies in the arrangement of the tubes, which are U-shaped, and are perfectly free to expand, while offering the largest possible amount of heating surface. Either steam or water can be passed through the tubes with equal facility. A "Twin Tube" steam trap, on the principle of the Bowdon tube, is also described in a leaflet. This is a highly ingenious device, depending for its action upon internal pressure generated by the heat of the steam within a tube permanently sealed at both ends.

Messrs. Crompton & Co., Ltd., are issuing fortnightly stock lists of electrical plant which they hold in readiness for immediate delivery.

Lists of single-throw quick-break knife switches, and one relating to a new design of I.T.E. circuit-breaker for the protection of car equipments, have come to hand from Messrs. R. W. Blackwell and Co., Ltd.

The Dudbridge Iron Works, Ltd., of Stroud, Gloucester, have brought out a capital catalogue of the Dudbridge gas and oil engines and gas producing plants, containing a number of excellent illustrations.

A copy of the tenth edition of their catalogue and treatise on "The Economical Transmission of Power" has been sent to us by the Unbreakable Pulley and Mill Gearing Co., Ltd., of Lower Gorton, Manchester. It discusses the general arrangement of shafting, couplings, loose collars, bearings, toothed wheels, belts and ropes, pulleys, clutches, erection and lubrication.

Trade Announcements.—We are informed that Mr. W. N. Furniss has joined the technical staff of the Pearson Fire Alarm System, Ltd., and that in future he and Mr. G. B. Bowell will act as joint electrical engineers to the company. This addition to the managing electrical staff has been necessitated by the rapid extension of the system.

Messrs. Le Carbone announce that they have removed to 17, Water Lane, London, E.C.

Messrs. Thomas Bolton & Sons, Ltd., have removed their London offices from 90, Cannon Street, to 110, Cannon Street, E.C.

We are informed that Mr. E. T. Oubridge is no longer connected with the Electrical Co., Ltd.

Liquidation.—A petition for the winding-up of the Electric Lighting Boards (British Manufacturing Co.), Ltd., presented by De Grelle, Houdret & Co., of London, and Sturm and Co., of Vienna, creditors, is to be heard in London on October 28th.

Punkahs.—The Indian Government has ordered from Punkahs, Ltd., London, a large number of Baildon's mechanical punkahs for use in the Imperial Secretariat, Calcutta. It is expected that after the Delhi Durbar the same make of punkah will be ordered for the Indian barrack.

Book Received.—"The Glasgow and West of Scotland Technical College Annual Report for 1902." Glasgow: The G. and W. of S. Technical College.

New Concentric Lampholder.—We have received from Mr. D. R. Broadbent, of 5, Albert Street, S.W., samples of a novel and useful lampholder for concentric-wired systems. Owners of such systems labour under the disadvantage of having to use lamps with special concentric caps, to fit the concentric holders; by a simple addition to the ordinary bayonet-socket lampholder, Mr. Broadbent has rendered it available for use on concentric systems, so that *any* ordinary bayonet lamp whatever can be used. The advantages of this improvement are obvious.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The B. of T. has warned the T.C. that the prov. electric lighting order will be revoked unless active steps are taken to carry it out.

Ashford (Kent).—The U.D.C. on October 14th held a special meeting to discuss the electric light question. It was reported that both Edmundson's Corporation and the General Electric Co. were quite prepared to accept the agreement drawn up by Mr. Medhurst, the Council's consulting electrical engineer, as amended, so as to protect the Council's interests, by the clerk. It was eventually decided that the Council should endeavour to enter into a contract to instal the electric light and generally proceed on the lines suggested by Mr. Medhurst.

Belfast.—It is reported that in a short time the well-known shipbuilding firm of Harland & Wolff, of Belfast, will equip the whole of its works for operation by electric power, and that the order for the supply of the necessary electrical machinery has been placed with the Lahmeyer Co., of Frankfort-on-the-Main. The *Frankfurter Zeitung*, which is the authority for the report, states that the electrical equipment will comprise two double-current generators, each of 2,360 H.P., and an alternator of 1,130 H.P.

Bracebridge.—The Committee of Visitors of Bracebridge Asylum has decided to engage an expert, to advise the Committee as to the cost of establishing electricity works at the Asylum.

Bradford.—Last week the chairman, Mr. J. P. Moorhouse, and deputy-chairman, Mr. C. E. Dowson, laid memorial stones in connection with extensions of the Valley Road electricity works. This station was designed in 1900 by Mr. R. A. Chattock, to meet and to forestall the rapidly increasing demand, and is to contain five generating sets of a total capacity of 10,000 H.P. One of these is nearly ready for running, and a second is well forward. The ceremony above mentioned related to the second section of the works, which has been commenced; unfortunately, the city electrical engineer, Mr. R. A. Chattock, was unable to attend, through illness. The old station, which contains plant of 7,500 H.P., is loaded up to its full capacity.

Included in the Bill which the T.C. proposes to promote in the ensuing session of Parliament, are provisions to enable the Corporation to charge for the provision of stand-by plant at the electricity works; to provide for electric motors on hire being privileged from distress; and to construct four additional lines of electric tramways.

Bridgend.—Sanction has been received from the L.G.B. to borrow £6,680 for electrical purposes.

Bridgwater.—The T.C. on October 16th decided to give its consent to a prov. order being granted by the B. of T. to the Bridgwater and District Electric Supply and Traction Co., Ltd., authorising it to construct works, and to supply electricity within the borough.

Brighton.—In view of the new generating station at Southwick being on the south side of Shoreham Harbour, the committee has had under consideration the proposal to construct a cast-iron tube 7 ft. in diameter under the harbour for the purpose of carrying the cables, and also as a means of access for the employés, instead of their using the ferry. It is proposed that a 10-ft. shaft be sunk on either side to a depth of 42 ft., and the bottoms connected with a 7-ft. tunnel, spiral staircases being provided at each end; the estimated total cost is £6,000. The Council ordered that the necessary bore holes be sunk to ascertain the nature of the soil to be encountered.

At the meeting of the T.C. on October 16th, the recommendations to apply for powers to extend the area of supply to 13 outlying parishes, and to improve the lighting of the Aquarium entrance, which were mentioned in the Electrical Review last week, were adopted.

The electrical exhibition being held in the Aquarium has been a great financial success, having been visited by no less than 34,593 people in the first 12 days. The Corporation has decided to continue it until to-morrow.

Brussels.—The Lighting Committee of the Communal Council is about to consider a project for the erection of a new electrical power station for the purpose of lighting the town. For a city otherwise so modern, Brussels is fearfully behindhand in the lighting of its streets.

Bulawayo.—The T.C. recently resolved that in view of the very heavy expenditure incurred by the Council by the present system of lighting the town with electricity, steps be taken forthwith to ascertain the cost of erecting the necessary plant for the lighting of the town by the Council itself.

Cardiff.—A deputation representing the Lighting and Electrical Committee had an interview with Sir W. T. Lewis last week in reference to the laying of mains on the property of the Cardiff Railway Co., for the purpose of supplying electric light and powers to tenants of the company. The result of the interview, it is said, was not favourable to the corporation.

Cleethorpes.—The T.C. has resolved to exercise its powers of purchase over the generating station of the Grimsby Tramways Co. at Cleethorpes.

Cromer.—The L.G.B. has sanctioned the borrowing by the U.D.C. of the sum of £25,000 for the purpose of electric lighting, to be repaid within a period of 25 years.

Dartmouth.—Ten arc lamps have been placed in prominent positions at Dartmouth, from Victoria Road to Newcomin Road. A trial will be made almost immediately, and should it prove successful the public lighting will at once commence. The arc lamps will be lit from dusk to 11.30, and then until dawn lights of 25 C.P. each (two on each arc standard) will be substituted. There are, in addition, 25 all-night glow lamps, and 90 to burn from dusk to 11.30.

Failsworth.—The D.C. has adopted the draft deed of transfer of the Council's electric lighting order to the Corporation of Manchester.

Falkirk.—It is estimated that this year's public lighting will cost £1,550, which is an increase in view of the introduction of the electric light. There will be 35 electric street lamps, and each of these will cost £16 10s. per annum.

Satisfactory progress is being made with the electricity works, and it is anticipated that the supply will be ready early in January.

Farnborough.—The B. of T. has written to the U.D.C. pointing out that the Council has not supplied electricity to the district under the order granted in 1899, and asking for any observations the Council may desire to offer, as the Board has now to decide whether the order shall be any longer in force.

Germany.—The utilisation of the water power of the Rhine in the vicinity of Mulhouse has been discussed for some years past, but the heavy cost of such an undertaking, has hitherto debarred its realisation. Such a project has, however, been prepared recently. It is calculated that 23,000 H.P. can be secured. The capital necessary for carrying out the requisite works is 15,000,000 marks. The B.H.P. will be sold at 100 marks per annum at Mulhouse.

Hanley.—The T.C. has adopted an alternative to the maximum demand system of charging for electric energy in the case of large consumers as follows:—For the first 1,000 units in one quarter, 6d. per unit; for the second ditto 5½d., for the third 5d., for the fourth 4½d., and for any additional quantity beyond 4,000 units 4d. per unit. This proceeding completely stultifies the use of the maximum demand system.

The T.C. has decided to extend the electricity mains so as to connect the electric sub-station at the refuse destructor works with the electricity works, and to enable current for street and private lighting to be supplied to the adjoining district.

Harrogate.—An inquiry into the application of the Corporation for power to borrow £46,000 for electricity works extensions was held last week by Major C. E. Norton on behalf of the L.G.B. During the first two years the works involved a loss of £1,997, but the third year produced a surplus of £777 after paying interest and sinking fund. In the following year the surplus was £1,046, and for the year ending March, 1902, £1,758. There was no opposition to the scheme.

Hastings.—The T.C. on Friday last had before it a report from the Lighting Committee respecting communications received from Dr. Kennedy, and from Mr. Leonard Andrews, the borough electrical engineer Dr. Kennedy had written some months ago to the Committee, pointing out that there had been scarcely any occasion during recent years to refer matters to him, and suggesting that it might be thought unnecessary to burden the undertaking with his retaining fee. The borough electrical engineer had also written resigning his appointment, in order that he might devote his time to private practice, but intimating that he would be willing, should the Council desire it, to continue to advise upon matters of importance in connection with the electrical undertaking. The Committee recommended that both Dr. Kennedy's and Mr. Andrews's resignations be accepted; that a resident electrical engineer, who shall devote the whole of his time to the duties of the office, be appointed at a salary of £300 per annum, to advance by yearly increments of £25 to a maximum salary of £500 per annum, and that Mr. Andrews's services be retained as consulting engineer at a fee of £100 per annum. It is proposed that all plans specifications, and estimates, &c., shall be prepared by the new electrical engineer, and that these shall be submitted to Mr. Andrews to report upon. It is hoped, by this means, to ensure continuity of the present practice. The chairman of the Lighting Committee, Dr. C. H. Allfrey, in moving the adoption of the report, expressed regret that the private work Mr. Andrews had in hand rendered it necessary for him to resign his present appointment. Reference was also made to the progress that had been made since Mr. Andrews went to Hastings nine years ago, when there were only 108 consumers on the books of the undertaking, and the gross profit on the year's working was less than £250, though the station had then been at work for 12 years. At the present time the undertaking can number 663 consumers, and it is estimated that the gross profit on the current year's working will be considerably over £7,000.

After considerable discussion, the recommendations of the Lighting Committee, as set forth above, were carried.

Honley.—There was some opposition at the L.G.B. inquiry held on October 15th into the application of the U.D.C. for a loan of £4,800 for electric lighting purposes. Out of a total of 2,400 8-C.P. lamps they wished to provide for, applications for 1,190 had been received, while for street lighting 75 16-C.P. lamps were to be provided. The system adopted was overhead wires, 200 volts, direct current. It was hoped that the supply would be provided at 3d. per unit.

Horley.—The Parish Council has received from Mr. R. C. Quin, of 13, Victoria Street, Westminster, an intimation that he and Mr. Marshall H. Bennett, of Horley, intend to apply at an early date for a prov. order to supply the parish. The promoters offer to light the town with 200 lamps for £2 5s. each, a saving of 13s. per lamp on the price now paid for gas, and to supply energy to consumers at 6d. or 7d. per unit. The Council has decided to support the application for a prov. order.

Hornsey.—At the meeting of the District Council on Monday, the Electricity Committee stated that having further considered the report of Mr. Robert Hammond on a supplementary scheme for electric lighting, it had been decided to withdraw the latter.

India.—An important letter from the Bengal Chamber of Commerce to the Bengal Government with reference to the Electricity Bill, is commented on in the *Times of India* for September 24th. What the Chamber particularly insists on is that the growth of electrical undertakings at home has been greatly retarded by restrictive and unnecessary legislation, and that it would be a great mistake to follow in India the lead of Great Britain. With reference to the amendments suggested in the text of the Bill, it would seem that they are offered as the outcome of an exhaustive inquiry carried out by a special sub-committee of the Chamber into the methods of Continental and American Governments, under whose direction the electrical industry has made great strides. In one important particular the committee of the Chamber is in opposition to the members who were appointed to report, for the Chamber does not recommend, as the report does, that the municipality should not have power to take over and work electrical undertakings.

Launceston (Cornwall).—The residents have decided to obtain a prov. order for lighting by electricity, which a company offers to undertake without cost to the borough.

Launceston (Tasmania).—The annual report of Mr. W. Corin, city electrical engineer, shows that the total costs for the year 1901 were £3,996, the total revenue £9,653, and the gross profit £5,657. After paying to interest on loans £3,465, and sinking fund £991, there remained a net surplus of £1,201. The accumulated deficit was thus reduced to £780, which has probably been wiped out by now. The capital expenditure to date aggregated £105,616, and the sinking fund to £5,476. The total capacity of the plant was 560 KW., and the maximum load 504 KW., the load factor being 17·30 per cent. There were 31,806 8-C.P. lamps or equivalent connected, and the net output for the year was 764,187 units, at 6d. and 3d. + 11s. per 8-C.P. lamp per annum, and 2d. to 1d. per unit for motors. The average price obtained was 2·52d. per unit for private lighting, 2·19d. per unit for public (arc) lighting; the works cost was ·779d. per unit. The motors connected numbered 44, of 194½ H.P.; the value of fittings on hire was £5,188, and of motors on hire £1,319. The average price charged per B.H.P. per annum was only £5 2s. 11d. The sale of energy for heating—mainly flat-irons—is rapidly increasing. There is a great deal of interesting matter in Mr. Corin's report. He is now preparing for the installation of new plant on a polyphase system, and is reporting on the cost of an electric tramway scheme for Launceston.

Leek.—The U.D.C.'s application for sanction to borrow £10,000 for the purposes of electric lighting has been sanctioned by the L.G.B.

Linthwaite.—The U.D.C. has given the following terms upon which it will allow Huddersfield T.C. to supply energy within the district:—Consumers to be charged only 5 per cent. more than consumers at Huddersfield, with terms similar to those in the borough in respect to motive power or large consumers, and that if the profits handed over from the electricity undertaking to the borough fund shall exceed the amount represented by a charge of ½d. per unit supplied throughout the whole area, a corresponding reduction shall be made to consumers within Linthwaite.

London.—The amount of electricity sold by the St. James's and Pall Mall Electric Light Co. for the quarter ended Michaelmas, 1902, is 1,249,657 units, estimated to produce £21,348, as against 1,040,417 units, which produced £18,077.

L.C.C.—The Council has granted an application from the Islington Borough Council for sanction to the borrowing of £18,356, repayable in 42 years, on account of the installation of electric light within the borough.

BERMONDSEY.—Upon the recommendation of the E.L. Committee, the M.B.C. has resolved to apply to the B. of T. for a prov. order authorising the Council to supply electricity in the parishes of St. Olave and St. Thomas and St. John. These parishes were added to Bermondsey under the London Local Government Act.

The Finance Committee reported having had under consideration an estimate of £4,185 for the extension of arc lighting to nine streets. The annual charge for each arc lamp will be £20, and as the number of lamps to be erected will be 55, with two incandescent lights of 32 C.P. each, the total annual charge will be £1,100. The number of gas lamps displaced will be 82 ordinary flat-flame burners, 10 incandescent burners, and six No. 4 Kern burners, the annual charge for which is £267 19s. The Committee recommended that the estimate of £4,185 be made a charge on capital works account.—The recommendation was adopted.

The same Committee reported having had under consideration an estimate of £1,190 for the substitution of electric light for gas in 13 side streets. The number of gas standards to be converted is 96. It is proposed to substitute for each gas lamp two electric lamps. The cost will be £384 a year (96 pairs of electric lamps at £4). The present cost of gas is £263 2s. 10½d. The Committee recommended that the estimate of £1,190 be made a charge on capital works account.—This was also agreed to.

Upon the recommendation of the same Committee, an estimate of £405, for extending the distributing mains in 11 streets, was made a charge on the same account.

It was reported that the number of equivalent 8-C.P. lamps applied for by private persons amounted to 9,500 to date.

A letter was received from the secretary of the County of London and Brush Provincial Electric Lighting Co., Ltd., stating that the directors are not disposed to make an offer to sell the Council their undertaking under the St. Olave Electric Lighting Order, 1896.

Mansfield.—At a meeting of the T.C. on Friday, the Electricity Committee reported that it had decided upon a scheme submitted by the engineer for the public lighting of the town for one year.

(Continued on page 708.)

THE NEW WORKS OF THE B.T.H. CO. AT RUGBY.

A few years ago we considered it our duty to bring any influence that we might possess to bear upon the minds of British manufacturers, to persuade them to strike out on more enterprising lines to meet the changing conditions of electrical industry. The reformation of existing manufactories, the abandonment of out-of-date methods and tools and antiquated paraphernalia, and the discreet and reasonable extension of works were among the courses advocated. At that time the importation of foreign electrical machinery even for our "home consumption"—not to speak of the attention which was being devoted to foreign countries by outside competitors—was becoming too large for those interested in the future of the British electrical industry to view it with equanimity. The business outlook—so far as mere volume of work was concerned—was becoming brighter and brighter, hence the necessity for a policy of wide-awakeness to be more energetically pursued than had sometimes been the case.

It is to the credit of many works owners and managers that the advice tendered was adopted, and some instances of this kind have been recorded in these columns from time to time. One result of this more energetic action—and perhaps it was inevitable—was the pursuance of a new line of procedure on the part of firms anxious to be in the running for our trade, but whose works were situated outside the confines of these tight little islands. No doubt it was seen that the time was rapidly approaching when greater preference would be shown toward machinery and plant of "British manufacture," and the difficulties of continuing in the old way would be greatly increased. Generally speaking, there is very little difference between a works put down by a British manufacturer on British soil, and one which is laid out on British soil, employing a majority of British labour, and with the assistance of British capital, but is really an offshoot of a foreign company. The designs and descriptions of the apparatus and machinery turned out may not be English, and much of the official headpiece may also be foreign, but we do not shut our eyes to the merits of inventions and designs because they are not the conceptions of Englishmen. The products of these works are fully entitled to hold honourable rank as "British manufactures," and as such they will stand a better chance than would otherwise be the case. Hence it is that the electrical fraternity, and we of the technical press, view with interest, and welcome cordially, the completion of the excellent new works which the British Thomson-Houston Co., Ltd., have erected at Rugby at a cost, we believe, of considerably over a quarter of a million sterling, money which, to a large extent, was furnished from English pockets.

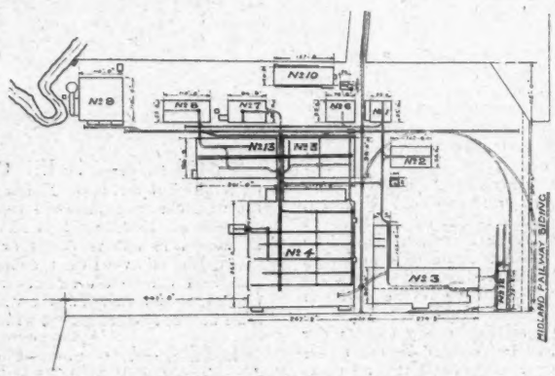


Fig. 1.—General Plan of B.T.H. Works at Rugby.

We had the pleasure of visiting these works on Monday last, in company with a few of our *confrères* on electrical tramway and other technical publications, and perhaps the first impression made upon our mind was the magnitude of the undertaking; secondly, the up-to-dateness of the equipment; and lastly, but by no means least in importance, the very considerate way in which the needs of the employés in regard to cleanliness, health, and general comfort have been attended to. A three-minutes' drive from the station, with a dive through what is not, we suppose, one of Rugby's most attractive features, brings one to the excellent set of red-brick buildings, the general arrangement of which may be gathered at once by a glance at the accompanying plan (fig. 1), and the bird's-eye view (fig. 2). The party was piloted through the various departments by Mr. Phipps, one of the works' managers; Mr. Oechsner, the chief of the Publications Department; and other very genial and attentive officials.

In casting about for a desirable site, various conditions had to be taken into consideration, such as the proximity to the centre of England, so that raw material could be procured and the finished product shipped to the various parts of the kingdom at a minimum cost for transportation, railway facilities, and nearness to the great industrial centres. The establishment at Rose's Wharf, Bankside, London, was of course inadequate to meet the new requirements. The site chosen lies north of the L. and N.-W. Railway station, and comprises some 25½ acres, of which about 10 acres are at present covered by roads and buildings, leaving room for further extensions.

Ground was broken on January 11th, 1900, and the erection of modern factory buildings began some six months thereafter. The total ground covered by buildings in square feet is 197,220, and the total floor space in square feet is 206,230. The works consist of 14 substantial steel and brick buildings, and have been so planned that extensions can be readily added as required without interfering with production.

Taking into full account the class and variety of apparatus to be manufactured, the primary object all through the entire plant, both in arrangement of buildings and of machinery, has been to avoid the material being carried backwards and forwards for the different operations, and as far as practicable, to bring in the raw material from the warehouse direct at the first point in the evolution of the finished product, passing it along from tool to tool in one direction to suit the various processes of machining, until it finally reaches the sections of the shops where it will be assembled, tested and erected. The London and North-Western and Midland Railways have sidings running into the works, so that heavy raw material entering the grounds can be brought direct to the stores, receiving section-iron foundry and machine shop. Standard-gauge tracks are also laid in the various buildings where the product is finished or stored, so that it can be loaded directly on to the trucks without re-handling.

In addition to the above a narrow gauge railway connects all the buildings in various directions for the ready handling of different products in course of manufacture.

The buildings are constructed of steel and bricks throughout, and are practically fireproof. They are isolated to a certain extent, in order to avoid fire risks, and the serious inconvenience which has been found as a result of having all departments under one roof. On all buildings requiring the maximum of overhead light glass roofs have been erected, while large windows give ample side light. The artificial illumination is by means of incandescent electric lamps, and enclosed-arc reflector lamps.

There are lavatories and washrooms of modern construction for the accommodation of the workpeople in all the chief buildings, the washrooms being fitted with wash-troughs, over which are hung swinging arm taps to furnish a supply of clean water for rinsing purposes. Lockers for storing the operatives' clothing are set between the rows of troughs, and are provided with separate keys.

Hydrants, with fire hose and nozzle attached, are plentifully distributed through all the buildings, and, as an auxiliary, those buildings containing combustible material are provided with an automatic sprinkler system, supported from the roofs. As a further protection, the company has organised an efficient volunteer fire brigade.

The sources of water for all purposes are an artesian well, located near the power house, and the Rugby town supply. The water from the artesian well is used for boiler feed and partly for condensing, and the town supply for boiler feed and other purposes.

For ease of reference and simplicity, all the buildings have been numbered thus:—No. 1, Timber Stores; No. 2, Incan-

descent Lamp Department; No. 3, Iron and Brass Foundry; No. 4, Main Machine Shop; No. 5, General Stores and

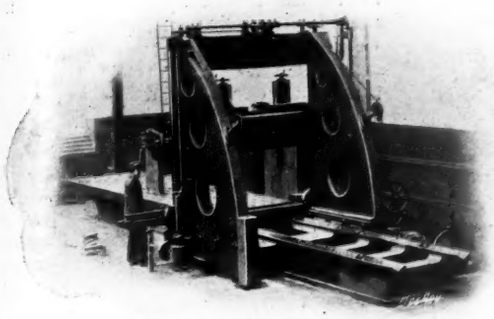


Fig. 3.—Electrically-driven Planer with Magnetic Clutch.

Warehouse; No. 6, Pattern Shop; No. 7, Punch Press and Blacksmiths' Shop; No. 8, Meter Department; No. 9,

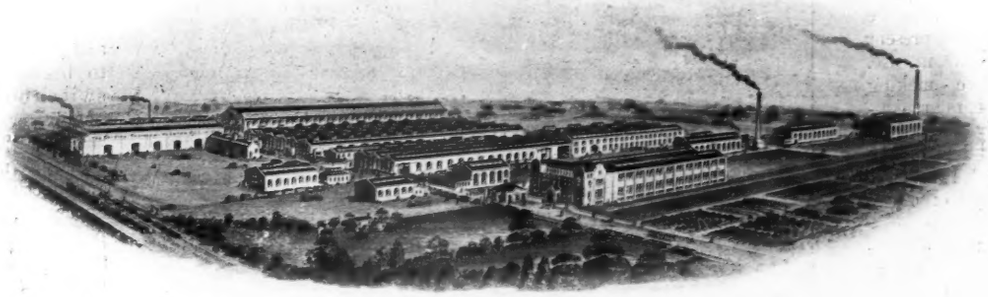


Fig. 2.—General View of the Rugby Works.

Power House; No. 10, Offices; No. 11, Gate House; No. 12, Sand and Coke Sheds; No. 13, Extension of Stores, Warehouse, and Shipping Department; No. 14, Oil and Paint Stores.

We shall now proceed to refer to the equipment of a few of these departments.

The incandescent lamp department measures 102 ft. 6 in. by 56 ft., and is arranged so as to be readily extended; it is completely furnished with modern appliances for manufacturing the B.T.H.-Edison incandescent electric lamps. The process of manufacture of these lamps is a complex one, but is claimed to be so efficient as to preclude the possibility of defective lamps leaving the department. The lamps are rated by the English standard candle, the candle-power being measured whilst the lamp is rapidly rotating, so as to give the mean horizontal candle-power.

The iron foundry consists of a 90-ft. by 274-ft. building. There is one large bay, with a lean-to on the west and a wing 41 ft. by 105 ft. of auxiliary departments on the east. In the lean-to are to be found the sand-mixing and core-making departments, the core-drying ovens, &c. In the eastern wing are located the brass foundry and cleaning departments. Extensions to the foundry have been planned to be eastward, such extensions to be duplicates of the main bay, which later on is to be exclusively reserved for heavy castings, the extensions being used for lighter work. The cupolas are placed at the south end, so as to be near the raw material stores, thus avoiding unnecessary handling, and also to prevent difficulties when extensions to the buildings are required. The Whiting cupola at present in operation has a capacity of 4 to 5 tons per hour and the one in course of erection (Evans cupola) will have a capacity of 10 tons per hour. An electric motor-driven blower provides the blast for the small cupola, and a similar arrangement will be installed for the large one when completed.

Opposite the cupola house on the south side, and alongside the standard gauge railway sidings, so as to readily receive the raw material with the minimum of handling, the storage sheds for sand and coke have been placed. The pig and scrap iron is stored in spaces along the railway siding where most convenient. A system of narrow-gauge tracks connects the various stores with the foundry proper and the core ovens, and also extends along the entire length of the building.

The crane equipment of the foundry at present consists of one electrically-operated 30-ton travelling crane, with 48 ft. span, having an auxiliary hoist of 2 tons capacity for general use. The crane has three motors, one for hoisting, one for longitudinal travel, and another for traversing. It is fitted with a "cage" on one end, occupied by the operator, and in this cage are located the controller, switches, and resistances. The controller is of the B.T.H. Universal type, which, by the movement of a single lever, controls any two motions of

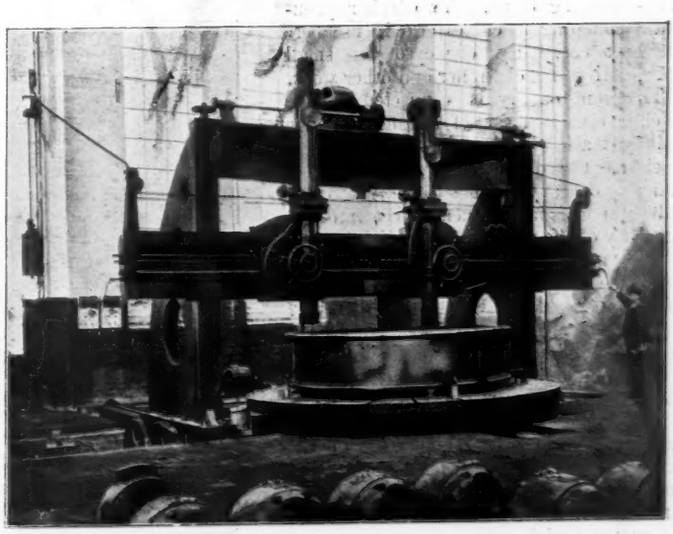


Fig. 4.—24-ft. Boring Mill.

the crane simultaneously required. In the wing running to the east there are two 2-ton hand cranes.

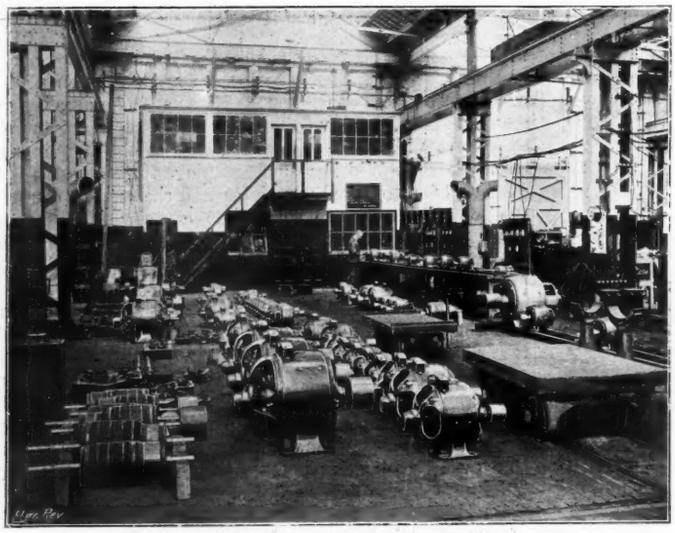


Fig. 5.—Testing Department for Small Motors and Generators.

The core ovens occupy a space in the lean-to at the side of the main bay, provision having been made for two large and four small ovens, of which one large and two small ones, fired from the outside, are at present erected and in use. The core-making departments are conveniently located in the east bay of the foundry in close proximity to the core ovens. There are in use in this department two Pridmore moulding machines for the moulding of controller backs, &c. The brass foundry is equipped with four crucible furnaces sunk level with the floor, a small core oven and an overhead hand-travelling crane. Two Tabor pneumatic moulding machines also in use here are kept constantly employed on small brass castings for controller and other work.

The iron foundry is connected to the machine shop by means of a standard gauge railway track (besides the narrow gauge tracks mentioned previously), which enables bulky and heavy castings to be loaded on railway trucks and taken direct into the large bay of the machine shop adjoining.

The machine shop consists of seven bays, the total dimensions of which are 267 ft. × 265 ft., giving 70,700 sq. ft. of floor space. The constructional steel work in this building is of a very substantial character, due to the heavy travelling crane which is used in one of the bays.

The primary object in the location of the machine shop and the arrangement of the machinery was to avoid, as far as practicable, material being carried forward and backward for the different operations, and to bring the raw material, such as shafting, copper, &c., from the stores, and castings from the foundry to the south end of the building, from there passing it in one direction from tool to tool to be machined until it reaches that section of the bay where it is assembled and erected. Other parts of the apparatus, such as armatures, spools, commutators and insulated parts are constructed in the north end of this building, and pass forward to meet the machined portions in the centre ready for assembling. All the machine tools, which are of the most modern and up-to-date English, American and Continental makes, are electrically driven (except the hydraulic and pneumatic tools), the large ones by individual direct-connected motors, and the smaller tools, conveniently grouped, by short lines of shafting. Particular attention has been given to the tools and jigs employed, by means of which absolutely accurate duplicates of any piece of apparatus can be produced. These special tools and jigs, while expensive as far as first cost is concerned, soon, owing to the great facility in reproducing exact counter-parts of material in use, pay for themselves. This system is used throughout the works, and so slight is the difference in dimensions between two similar pieces of machined material as to be quite negligible.

Fig. 6.—View of Commutator Department.

Bays A, B, C, D and E are devoted to work on iron and steel, while Bays F and G are devoted to brass work and switchboard assembly.

Bay "A," for heavy machining and erecting of large apparatus, is equipped with a 40-ton overhead electric travelling crane of 66 ft. span, similar to the one in the foundry previously described. The south-west part of this bay contains an 84-ft. × 20-ft. planer, shown

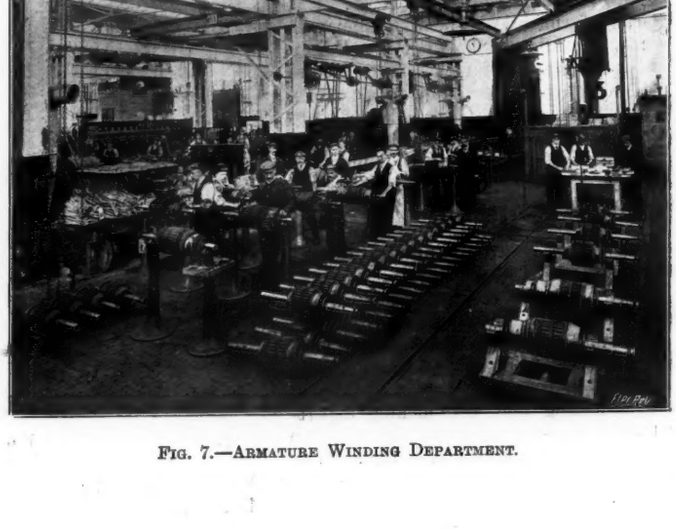


Fig. 7.—Armature Winding Department.

in fig. 3, equipped with direct electric drive and B.T.H. magnetic clutch, the latter of which permits the motor operating the planer to revolve continuously in one direction. There is also a large 24-ft. boring mill (see fig. 4) equipped with electric drive, one motor of which operates the table, another the housings, and a third the cross head to which the tools are attached. A large heavy lathe, having a 24-ft. bed, is located in the south-west corner of this bay, this machine being suitable for turning up large commutators and heavy shafts, in addition to other large general work. There are also in this bay a portable slotter, milling and boring machine, and portable keyway-cutter and large radial drill, all fitted with electric drive. A large floor plate, at present 24 ft. × 20 ft., but which can be increased to 50 ft. when necessary, is also located in this bay, and will be used in connection with the various portable machines referred to above. In the north end of Bay "A," as well as in Bays "B" and "C," is located the testing department of the company (fig. 5).

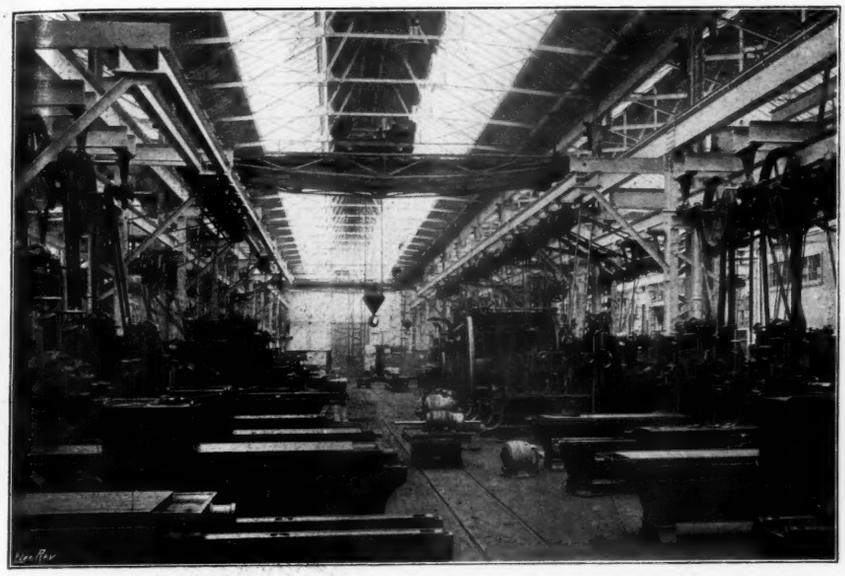


Fig. 8.—Machines for Operating on Railway and Stationary Motor Frames.

Bay "B" has two 5-ton three-motor electric overhead travelling cranes, besides several pneumatic 2-ton jib cranes. The north end is used for testing purposes, the centre for assembling and erecting tramway and stationary motors and small generators; the southern portion is temporarily vacant, but is ultimately to be equipped with moderately large tools for work of medium weight. A system of piping for portable pneumatic hammers, chisels and drilling devices is also located in this bay.

Bay "C" has the same sized crane and similar pneumatic arrangements to those in "B," with the addition, however, of a combination hydraulic and pneumatic press for special pressing and riveting of laminated pole-pieces, &c. There are located in the south-west part of this bay planers, slab milling machines, radial drills, four-spindle railway motor boring mill, fitted with electric drive, and in the south-east part several smaller planers, horizontal and vertical slab millers, vertical and horizontal boring mills, which are used for various operations in connection with railway and stationary motor frames (fig. 8). Besides the above, there are four special boring mills designed by the B.T.H. Co. for the purpose of accurately and automatically boring out axle and armature shaft receptacles for railway motor bearings, also for boring the seats on generators and motors for field magnets and pole-pieces. By the use of these special machines a vast amount of labour is saved on the part of the workmen in laying out their work, therefore increasing production and ensuring absolute accuracy in duplication. Most of the drives from the motor to the countershafting in this bay, as well as in the others, are by means of the Hans Renold silent chain drive.

Bay "D" has only one 5-ton overhead electric one-motor travelling crane. In its southern section (see fig. 11) there are arranged in groups lathes, milling machines and small vertical turning and boring mills, all of which are used for work in connection with railway and stationary motors. The northern section of this bay is devoted to the manufacture of commutators, with benches for assembling them and hydraulic presses for pressing the commutators on the shaft, besides milling machines and lathes for milling the commutator slots and turning the same. A view of this section appears in fig. 6.

Fig. 9.—Switchboard Department.

The assembling department at which the various parts of the motors, &c., arrive in the course of manufacture is located in the centre portions of Bays "B," "C," and "D"; the smaller parts progress to Bay "D," being

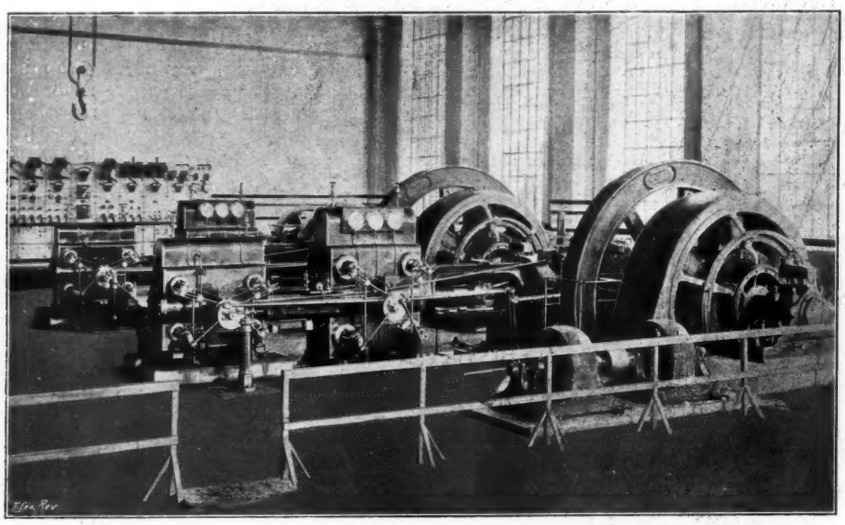


Fig. 10.—Interior of Power House.

there assembled and sent to Bays "C" and "B," where they meet the frames and heavier sections of the motors and generators, from whence they go to the testing department immediately adjoining.

In the south-west section of Bay "E" are located a large

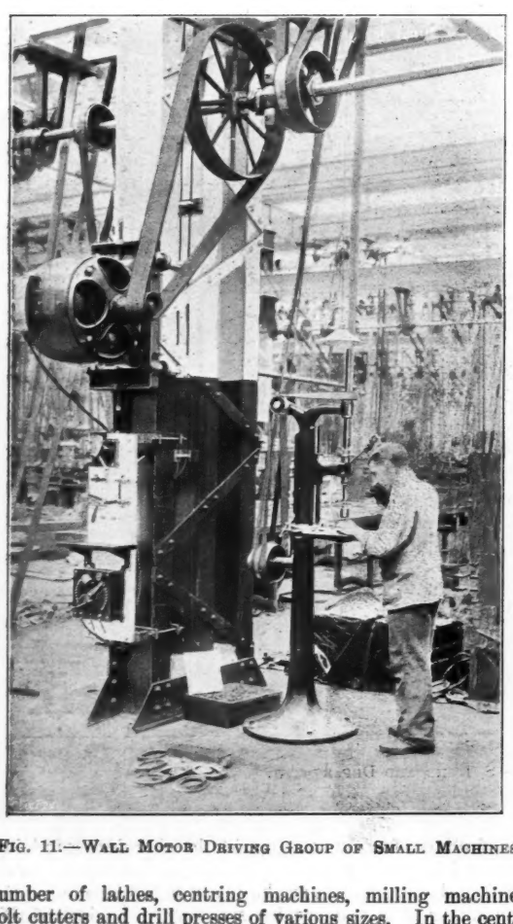


Fig. 11.—Wall Motor Driving Group of Small Machines.

number of lathes, centring machines, milling machines, bolt cutters and drill presses of various sizes. In the centre of this bay is located the tool room and tool store. The tool room is equipped with special chucks, solid and expanding reamers, mandrels, internal and external micrometer gauges for turning, boring, and general dimensioning, besides other special appliances designed by the B.T.H. Co. for the testing and inspection of machine work. Besides the above, there are special measuring standards and limit gauges, by means of which the greatest accuracy is secured, and the proportion of error is limited to the least possible dimension. The testing and inspecting of apparatus in various stages of manufacture is an important item with the company, and if not up to a high standard, it is rejected before passing to the completed stage. For a company doing the large variety of work that the B.T.H. does, a large number of special tools made up from time to time to suit particular lines of production in hand are required, and the tool room is fully equipped with tools designed and invented by the company, the aim of the

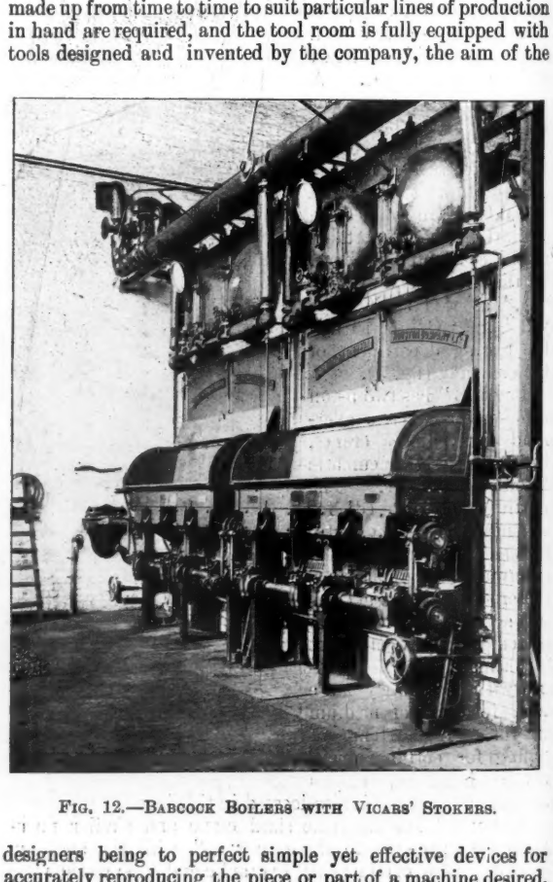


Fig. 12.—Babcock Boilers with Vicars' Stokers.

designers being to perfect simple yet effective devices for accurately reproducing the piece or part of a machine desired. A system of limiting the workman to a certain number of tools is in vogue in the tool room, by which he is

allowed to have only a certain number of tools for use at one time.

Bay "F" has one 5-ton single-motion overhead electric travelling cranes, and the southern section is equipped with lathes, screwing machines, drill presses and benches for necessary brass work for railway and stationary motors, controllers, switchboards, arc lamps, &c. The centre of the bay is equipped for the finishing, assembling and testing of tramway controllers, the northern end being arranged for the production of controller cables and similar work. In the northern section are also located the winding departments.

The south end of Bay "G" (see fig. 9) is arranged for the drilling and assembling of switchboards.

In the northern sections of Bays "E," "F" and "G" are located the armature winding and insulating departments (see fig. 7), where the coils are dipped, formed and taped, the armatures wound, and passed on to the commutator department for the assembling of the commutators on to the shafts and for connection to the coils. After the individual coils and completed armatures have been wound, they are put through a drying and impregnating process, by which the moisture is driven out and the coils impregnated with insulating compound, rendering them thoroughly moisture-proof. Each armature coil as well as magnet coil is carefully tested for insulation resistance before being assembled, which process is repeated after assembly, so that should there be any insulation faults in the coils they are discovered before the work has progressed very far on same. This department also contains special winding machines for winding field magnet coils of the latest form. Before winding the armatures, each core is carefully balanced with the shaft before coils are placed in the slots, and also after the coils have been placed in position. The main object in locating the armature and field winding departments in the north end of the building was to avoid metallic substances or any foreign material which would tend to produce a short circuit coming in contact with the insulation, and to preserve the same in the highest possible state.

Bay "H" is a lean-to connecting with the main building, in which the polishing, electro-plating, tin smithing and tool hardening sections are located.

The testing department, of which we give a view in fig. 5, occupies the northern sections of Bays "A," "B" and "C," and is designed for accurate testing of all apparatus manufactured by the company, such as alternating and direct-current generators, stationary tramway and induction motors, controllers, transformers, rotary converters, rheostats, arc lamps, switchboards, &c., besides all insulation used in production.

There is also a special high potential testing section for determining the value of the insulation of all materials used in the manufacture of the apparatus. This consists of high potential transformer, capable of generating up to 50,000 volts, together with elaborate device for analysing insulations under various degrees of heat and variable potentials. The arc lamps are tested on a specially designed rack, on which the proper current and the E.M.F., either direct or alternating, is supplied. While on this testing rack the lamps are operated as far as possible under service conditions. While under test the lamps are inspected by competent experts for any mechanical faults, gauges being supplied to the inspectors to facilitate this work.

The storehouse and warehouse is served by several electric cranes.

All the tools and machinery in the pattern shop (No. 6) are operated by electric motors, which are placed on brackets overhead, so as to occupy the least possible space. The machinery consists of the most modern and up-to-date wood-working machinery, such as lathes, planers, circular saws, drills, &c.

Building No. 7 is the punch press and blacksmiths' shop, the southern section being occupied by the punching department, and fitted up with punch presses for stamping out armature sheets, pole-pieces and general sheet metal work. The punches are all electrically driven by motors placed on brackets overhead. The machines in this building range from 84-ton to 12-ton presses. The northern section is devoted to the blacksmiths' shop, and at present contains three forges, hammer, drop press and cutting shears, all operated by electric motors placed overhead. There is also a large modern annealing furnace for annealing all classes of iron used for armature field magnets and transformer punchings, besides other work that requires annealing. The blast for the forge fires is produced by an electrically-driven blower, which also acts as an exhaust for the smoke and fumes rising from the forge fires.

The meter department (No. 8) is thoroughly equipped with apparatus and instruments of precision for testing O.K. and Thomson recording wattmeters, besides containing separate and well-equipped up-to-date chemical and electrical laboratories.

On receipt of Thomson or O.K. meters from the factory they are erected on specially constructed stands, and each meter is examined; on the examination proving satisfactory a high-potential insulation test is made between the windings and frame; this proving satisfactory, a current is passed through the field winding and measured by means of a *standard* Thomson inclined-coil wattmeter, which is periodically checked against a Kelvin standard composite balance; the volts applied to the pressure circuit of the meter are measured by means of a standard Weston voltmeter. A number of revolutions of the disc are timed against a stop watch which is constantly checked against a chronometer, and the meter adjusted till the watts applied agree with the watts registered by the dial. When each meter is reading accurately a certificate of test is written out and placed inside of same. The covers are enamelled, and then stored in an oven specially constructed for the purpose. One of the operations controlled by the laboratories is the admixture of pig irons to produce sound castings of high permeability for construction of motors and dynamos.

Arrangements are made so that with each casting there is cast to same a test piece. The test pieces are afterwards detached from the castings, turned down, and tested in the electrical laboratory to ascertain, before the casting passes into the machine shop, whether its magnetic quality is up to the high standard demanded. The wrought-iron and mild steel used for armature stampings are investigated as to their permeability, hysteresis loss, ageing, &c. In the casting of copper, bronze, gun-metal and brass, experiment goes hand-in-hand with practice, resulting in sound castings, possessing high tensile strength, uniformity of colour, and high conductivity where needed. In the selection of other alloys, such as bearing metals and anti-friction alloys, particular attention is paid to their coefficients of friction, hardness, and chemical composition. Another important item dealt with is that of varnishes, japans, &c., used for insulating purposes. These are submitted to rigorous tests for insulation and chemical purity. The purity and efficiency of lubricating oils and greases also receive attention. The very interesting and little-known subject of metal colouring is similarly studied, and the discoveries are applied in the dipping and plating departments. The work of the laboratories is not solely that of testing the qualities of the materials used in the works, for the microstructure of iron, steel and alloys, is being vigorously pursued in relation to the electrical properties of these materials and the facts discovered are tabulated and applied in the works.

The power house is shown in our figs. 10 and 12. It is 110 ft. × 110 ft., and is divided into engine room and boiler room. There are three steam generators, two of which, of 200 KW. capacity each, supply continuous current at 550 volts. They are coupled direct to horizontal tandem compound Corliss type engines. The engines, made by Messrs. Cole, Marchent & Morley, are each capable of giving a normal output of 320 I.H.P. when running at 120 revolutions per minute, 150 lbs. steam pressure.

The small set is a 100-KW. 550-volt continuous-current generator, coupled direct to a Browett-Lindley horizontal tandem compound engine running at 235 revolutions per minute. The condensing plant is of the Wheeler Condenser Co.'s "Admiralty" type, with 1,200 sq. ft. of cooling surface, mounted on combined steam-driven air and circulating pumps. The condensing water is taken from a cooling pond and artesian well. The boiler house contains two Babcock boilers, fitted with superheaters, also Vicars' stokers, driven through worm gearing by a 5-H.P. motor running at 675 revolutions per minute. A third boiler is to

be immediately installed. The economiser contains 320 pipes of the Clay Cross Co.'s make, the scraper gear being driven by an electric motor. The boiler feed pumps are two in number, one by Pearn & Co. of the three-throw vertical type, driven by a 15-H.P. motor running at 840 revolutions per minute, and the second by the Blake-Knowles Co., of the single-ram horizontal direct-acting type. There are also two vertical three-throw lifting pumps by Pearn & Co., each geared to a 5-H.P. motor running at 1,200 r.p.m. The water is treated by Tyack's water softening process before passing into the boilers. All the main steam and feed piping is made of lap-welded steel, and is erected on the ring system. In the pump room there is also an air compressor, driven by a 60-B.H.P. motor running at 550 r.p.m. This compressor is for supplying air at a pressure of 75 lbs. per sq. in. to the pneumatic tools in the works.

Coal is conveyed direct into the boiler house, and the ashes are brought out by means of an elevator, and emptied into trucks.

A balancer set, consisting of two small generators, is installed in the station for the automatic adjustment of the three-wire lighting circuits. The switchboard is designed for the control of the three generators and balancer set, and of the output of the same for lighting and power.

It is provided with a duplicate set of bus-bars, so that the circuit to the testing department may be run independently of the other circuits on either of the generators, this provision being made so that the other circuits may be free from disturbance due to short circuits in the testing department. The lighting circuits are run off the three-wire system, and the circuit-breakers protecting the two outer conductors are electrically interlocked, so that it shall be impossible for the full voltage to be thrown on the lamps on either side in the event of a short on one side of the middle wire. The board is equipped throughout with standard B.T.H. magnetic blow-out circuit-breakers, quick-break switches, &c., and with switchboard instruments of the latest B.T.H. pattern, the astatic type. The board is constructed of blue Vermont marble, giving a very handsome appearance by artificial light.

Throughout the works the clocks are electrically operated on the synchronome principle. The hours for the operatives are on Mondays from 7.30 a.m. to 5.45 p.m., with an interval for dinner each day from 12.15 to 1.15; on other days the hours are 7.15 to 5.45, with the exception of Saturdays, when work ceases at 12 noon, making the total number of working hours per week 52.

Building No. 13 has galleries which will be used for light manufacturing purposes, the west side exclusively for making up insulations, the winding, forming, mounting and assembling of moderate size, and small armature coils, small magnet coils, fan motor winding, arc lamp winding and small transformer winding. The east gallery is designed for the machining and assembling of arc lamps, fan motors, small switches, circuit-breakers, and other supplies. The lower floor is used for the storage of finished apparatus, for box making, and as a shipping department, and has a loading platform from which goods can be directly transferred to railway trucks standing on the main works tracks or running through the central bay of the building, the loading of larger pieces of machinery being facilitated by the large crane previously mentioned as running through the centre of this and Building No. 5.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 701.)

Northampton.—The T.C. on Friday decided to commence the erection of an electricity station at once. The cost of building is estimated at £12,000.

Nottingham.—Col. Hepper held an inquiry on Tuesday regarding an application by the City Council for sanction to borrow £35,500 for purposes of electric lighting. The city accountant informed the inspector that the assessable value of Nottingham was now £940,217, the outstanding loans under the Sanitary and Public Health Acts £1,113,463, and the population about 240,000. The town clerk explained that the application was to borrow two sums of £15,500 and £20,000, which had been authorised by the City Council for electricity purposes. The first was for a station at the Eastcroft, where the Corporation was now adopting new destructors. Mr. H. Talbot, city electrical engineer, said there were now 2,060 consumers, including power and light. The £10,000 which was borrowed in the early part of this year had already been spent in the laying of mains, &c.

Portslade.—The U.D.C. on October 15th discussed the proposal of Brighton Corporation to obtain powers to supply energy to Portslade and other places outside the borough. It was decided to ask Brighton T.C. to state the terms and conditions under which they would be prepared to supply electricity to the town.

Redditch.—At a meeting of the U.D.C. to consider the estimates for the coming half-year, it was stated that the municipal electric lighting undertaking caused a heavy annual loss, amounting to £1,000 or £2,420, according to different speakers.

Rowley.—The Midland Electric Corporation has given notice to the U.D.C. that the Corporation is prepared to supply the Council's district with electricity from the sub-station at Old Hill.

Slough.—The U.D.C. has decided to transfer its E.L. prov. order o the Slough and Datchet Electric Supply Co., Ltd., subject to the consent of the B. of T.

Spain.—The Spanish Minister of Agriculture and Industry has issued the following statistics on the subject of electrical installations in Spain:—In the year 1901 there were in the kingdom 859 electric power stations, 648 of which were for public service and 211 for private use. The total number of incandescent lamps in use for public purposes reached 87,112, and 1,470 arc lamps. For private use there are in service 1,237,836 incandescent lamps, and 2,819 arc lamps. The price of electrical energy in Spain is 5 pesetas per month per lamp of 10 C.P. Central power stations operated by waterfalls reduce this price to 1·75 pesetas. In large towns the price reaches sometimes 1 peseta the KW.-hour, but at Alzola it falls as low as ·27 peseta, which is the lowest rate in the kingdom.

Sudbury.—The E.L. Committee reporting on the offers received for taking over the electric lighting prov. order, recommended that of Mr. Adrian Collins, of 61, Old Broad Street, London. The main points were:—If the Corporation lease the order to a substantial company, Mr. Collins will undertake to satisfy the Corporation that the proposed work will be carried out in an entirely satisfactory manner, and that the company will be able effectually to perform its obligations for a period of at least 20 years, at the end of which period the Corporation will have the right of acquiring the undertaking at its valuation as a going concern. The value of the goodwill is to be settled by an arbitrator, but no sum to be included for compulsory purchase. On completing the contract with the Corporation, Mr. Collins offers, in lieu of £1,000 cash payment, to pay the Corporation £300 by way of premium, £30 per annum for the first period of 10 years, and £100 per annum for the second period of ten years by way of lease. Such sums are not to be repaid by the Corporation. The Corporation is to grant a concession for public lighting, as soon as the existing contract with the gas company ceases, for a period of five years, at a charge of £2 per lamp per annum, the burning hours being set out as 1,500 each lamp per annum. Mr. Collins agrees to use Nernst lamps, equal to from 30 to 40 C.P. The Corporation also agrees to take a supply of energy for all public rooms and offices. The charges for energy shall not exceed 7d. per unit for lighting and 3d. per unit for motive power. The Committee unanimously recommended that a provisional contract be entered into between the Corporation and Mr. Collins, and that Mr. Hawtayne be instructed to have this prepared. The report was adopted without discussion.

Swansea.—The Council has proposed that in this district motors be stocked and let on hire. Messrs. Horsfall's tender has been accepted at £9,500 for a dust destructor.

Switzerland.—The Oerlikon Co. proposes to establish at Pföffikon a hydro-electric station of 60,000 H.P. It is intended to close by means of dams the Tinsiedeln Valley, and to there form a lake 12 km. square, supplying the necessary water by means of the Reinchenback and the Trossback. The concession has been obtained gratuitously from the State, with the reservation that the latter has the option of purchase within a period of 100 years. The cost of the undertaking is estimated at 40 million francs, the greater part of which is already in the hands of the promoters.

Teddington.—The U.D.C. has received offers for leasing its electric lighting order from Messrs. Crompton & Co. and the Twickenham and Teddington Electric Supply Co., Ltd. Mr. Edgcome, electrical engineer, has been engaged at a fee of £5 5s., to report on the offers, and to advise the Council on various matters.

Teignmouth.—The U.D.C. has practically completed arrangements with Messrs. Crompton & Co. for the transfer of the prov. order, and the B. of T. has postponed the revocation of the order for 12 months.

Tunbridge Wells.—Last week a L.G.B. inquiry was held by Colonel A. J. Hepper, R.E., in respect of the Council's application for a loan of £10,000, needed in consequence of the

increased development of the electric light system. There was no opposition. The chief items included in the estimates were:—Condenser and foundations, £1,421; cooling tower, £1,200; cables, mains, &c., £2,764; 200 meters, £1,000; services and lamps, £500; feed pumps, £300; buildings, £633; boilers, £170; and several lesser amounts. The borough electrical engineer, Mr. H. Boot, explained the positions of the works and the nature of the additions.

Wigan.—A new building for the purposes of the Mining and Technical College is being erected at Wigan, at a cost (including equipment) of £50,000. A bazaar and exhibition held last week resulted in £5,650—nearly the full amount that was required to open it free of debt—being handed over to the committee. The electrical part of the exhibition, illustrative mainly of the uses to which electricity can be applied in mining, was singularly interesting. Many of the best known makers of machinery and appliances in Lancashire were amongst the exhibitors.

Yarmouth.—The T.C. has resolved, on the recommendation of the consulting engineers, Messrs. Preece & Cardew, to apply for leave to borrow £16,500 for extensions of the electricity works and mains. The estimates are as follows:—Boilers, £2,200; economisers, £1,000; 300-kw. set, £3,000; switchboard, £500; mains and sub-stations, £3,800; buildings, £4,500; engineering, &c. £1,450.

ELECTRIC TRACTION NOTES.

Bingley.—The U.D.C. on Monday decided to apply to the B. of T. for a tramways order.

Birkdale.—The difficulties between the L. and Y. Railway Co. and the British Electric Traction Co. in connection with the level crossing at Aughton Road are now removed.

Bournemouth.—The tramline between Lansdown and Boscombe, *vid* Holdenhurst and Ashley Roads, is now complete, and on October 8th the first car, containing several members of the Tramways Committee and officials, ran over this important section of the tramway system. Everything was found to be in good order, and as soon as the Board of Trade inspection has been made, it is intended to commence the public service on the line, which provides a direct means of communication between the Central Station, Bournemouth, and Boscombe.

Brighton.—At a Council meeting of the 16th, a special report was presented by the Tramways Committee respecting a tramline between the existing terminus in Dyke Road at the Seven Dials and the sea. After considering a report by Mr. Kincaid on the matter, the Committee came to the conclusion that the route adopted should be by way of Vernon Terrace, Denmark Terrace and Montpelier Road to the Front. In the event of lines being laid by the Hove Corporation in Western Road, Hove, it would also be necessary to lay a line between Montpelier Road and the western boundary. The Committee recommended that the town clerk be instructed to include these new routes in the proposed Bill, and also to obtain the necessary powers to widen the street in various places where rendered necessary. The Council passed the proceedings after a lengthy discussion.

Brussels.—The transformation of the various lines hitherto worked by animal traction is proceeding rapidly. The entire line from Brussels-Midi to Forest will be run electrically from November 4th next, and will be worked on the overhead system. It was hoped that the new electric lines of the central boulevards would have been in working order before this, but it appears that the present existing power stations of the company cannot meet the extra tax on the supply of current, and the new power station in the Rue de Birmingham will not be ready for some months yet. The station in question has just been roofed, and at the present moment the coal bunkers are being installed, and the machinery foundations are being laid down.

Dudley.—At a special meeting of the T.C. last week a resolution was carried instructing the town clerk to take steps to complete the purchase of the tramways within the borough under an agreement with the British Electric Traction Co made before the Board of Trade in 1898. It was explained that the Council had no option but to take over the lines as agreed upon and lease them to the Traction Co. for 21 years.

Egham.—Mr. S. Sellon, engineer to the promoters of the Staines and Egham electric tramways, attended the meeting of the U.D.C. on October 14th, and asked for the Council's assent to the introduction of a Bill during the present session of Parliament. Before taking any action in the matter, it was decided to ascertain whether the London United Tramways Co. intended to extend its lines from Staines to Egham.

Glasgow.—The extension to Yoker is now complete, and will be opened formally in a few days.

Lancing.—Worthing T.C. has asked the Parish Council not to commit itself to any other scheme of electric tramways until it has received the details of the Corporation's scheme. When the matter was considered on October 17th, it was stated that the Council had already committed itself to the scheme of the B.E.T. Co., and under the circumstances no action was taken in the matter.

Hamilton, N.B.—The tramway company, who are at present laying down lines from Wishaw to Motherwell, Hamilton and Blantyre, have intimated that they intend applying for a provisional order for a new line to Larkhall and the surrounding districts.

Hebburn.—The U.D.C. has asked the Northern Counties Electricity Supply Co. to meet the Council, to discuss the question of providing electric trams for the district.

Hollingbourne.—The Kent Power Co., Ltd., has asked the R.D.C. to sanction a scheme of electric tramways through the district from Chatham to Maidstone. The Council is prepared to give favourable consideration to a scheme.

Hove.—Very considerable opposition continues to be raised against the Corporation promoting a Tramway Bill this session. A very strong Ratepayers' Defence Committee has been formed. Circulars have been sent out to all the ratepayers, and over 1,000 have been returned, the majority of which oppose the introduction of tramways altogether.

Huddersfield.—The Council has decided not to proceed with the proposed extension to Newsome, a district within the borough, on account of the expense which would be entailed other than the cost of the actual construction of the line.

Ilford.—The Tramways Committee has recommended the U.D.C. to apply to the B. of T. for a prov. order for the construction of four additional lines of electric tramways.

Liverpool.—The final meeting of the Tramways Committee was held last week, Councillor S. W. Higginbottom, M.P., presiding. In the course of a statement on the working of the tramways during the year, the chairman said that during the nine months of the present year ending September 30th, there had been an increase of 9 per cent. in the passenger traffic. Taking the figures for the corresponding nine months of 1897, the last year of the company's control, the increase had been:—Passengers, from 29,000,000 to 82,000,000; mileage, from 4,500,000 to 9,000,000; revenue, from £219,000 to £380,000. The average 1d. stage was now 2½ miles in length. The Old Swan route had been extended to Knotty Ash the Garston Tramways had been taken over and equipped, and through communication had been provided from Garston to Seaforth, *vid* the centre of the city and the Pierhead, covering a route 10½ miles in length. The total cars in the service had been increased from 365 to 400 for ordinary requirements. These cars ran each day 7,394 trips. The traffic commences at 4.30 a.m. and finishes at 12.30 a.m. The system was only closed four hours out of the 24, and in this period most of the cars have to be cleaned and the testing and maintenance of the overhead equipment attended to. The efficiency of the system was being continually improved, as was evidenced by the number of emergency calls in the nine months compared with the same period in 1901, being—1901, 1,874; 1902, 866, a decrease of 54 per cent. The car failures during the period had decreased by 29 per cent. The fatal cases declined from eight in 1901 to 5 in 1902. The Committee had given very careful consideration to the question of providing more comfortable accommodation for outside passengers in inclement weather, and the general manager had succeeded in perfecting a type of cover which afforded great protection in wet and cold weather; it had been found possible for 40 cars to be placed in the service in the present year. Judging by the average car-mile earnings, it was clear that the greatest possible accommodation was provided consistent with the careful administration of the undertaking.

Oldham.—On Thursday last week the new electric tramway sections from Huddersfield Road to Moorside (1¼ miles), and from the borough boundary along Chadderton Road, Barker Street, and Henshaw Street (7 furlongs), were inspected by Major Druitt, of the B. of T., who gave his provisional sanction to the running of the cars as early as the Tramways Committee desired.

L. & Y. Railway Electrification.—The following important statement appeared in yesterday's *Financial Times*:—"The directors of the Lancashire and Yorkshire Railway decided at their meeting on Wednesday to electrify their Liverpool and Southport Railway, which is about 18¼ miles long, and which carries a very large residential traffic. All the detail plans for this work have received careful consideration during the past 12 months, and the various experiments which have been tried at the Horwich works have resulted in decisions upon important points of operating, thus enabling the work to be put in hand at once. It is anticipated that if the contractors, who have already been selected to manufacture such portions of the plant as the railway company will not construct at its own works, can deliver early enough, the trains will be running in nine months. If this be done, the Liverpool and Southport line will be the first main line to be converted to the new system in this country."

Rowley Regis.—The U.D.C. on Monday decided, in conjunction with Quarry Bank and Brierley Hill Councils, to apply for power to construct electric tramways from Halesowen Road, Old Hill, to Halesowen boundary, from Blackheath through Rowley to the Dudley boundary, and from Blackheath to Gorsty Hill. Mr. R. P. Wilson was appointed engineer to the scheme.

Spain.—The Zaragoza Tramways Co. has been authorised to convert three of the horse tramways in the town of Zaragoza into electric lines.

Wellingborough.—A U.D.C. Committee has been appointed to consider the electric tramway question.

Swansea.—The Dolter Electric Traction Co. has invited the members of the Tramways Committee "and any other members of the Council who may take a special interest in electric traction," to visit Paris (free railway and hotel expenses) to inspect the Dolter surface contact system at work there. When the matter came before the Electric Lighting Committee last week it was "jocularly moved" that the letter lie on the table. Some discussion followed as to whether it was intended to regard "the invitation in a serious light, or as an attempt to get at the Corporation." One speaker remarked that "if he thought it was made in any other than a business way he should treat it with scorn." Mr. Solomon moved that the consideration of the letter be adjourned until the Committee had received a report from the sub-committee as to the working of the Dolter system. Mr. Tutton pointed out that the sub-committee could not report till they had visited Paris and seen the system at work. He moved an amendment that the letter be referred to the whole Council, inasmuch as it now affected not the Committee only but the whole Council. Mr. D. Davies seconded, and after further discussion the motion was carried. It will be remembered that the Kingsland mechanical surface contact system has recently been fully considered by the Swansea Committee; in fact, we were under the impression that it had been practically adopted.

Switzerland.—The Oerlikon Co. has contracted with the Swiss State Railway authorities to experimentally convert the railway between Seebach and Wetting, a distance of 20 kilometres, into an electric line on the Oerlikon single-phase system.

Willenhall.—There has been a number of trial trips on the new electric tramways constructed by the British Electric Traction Co. from Willenhall to Darlaston, and from the former place to Dean's Road, the boundary of Wolverhampton. On Friday last week representatives of the various local authorities through whose districts the lines run were invited by the company to an inspection and a trip, and everything passed off satisfactorily. The lines now only await the inspection by the Board of Trade prior to being opened for traffic.

TELEGRAPH AND TELEPHONE NOTES.

Aberdeen Telephones.—The Town Council has decided to watch the results in other towns before deciding whether to proceed with a municipal scheme.

Cable-Laying Perils.—The cable steamer *Newington* secured the St. Lucia end of the St. Vincent cable on September 21st, four and a half miles from the Soufrière volcano, on the island of St. Vincent, and had just finished buoying it, when there was a violent eruption of the volcano without the slightest warning. The steamer thereupon headed away from the land, followed by dense clouds of smoke. We read in the *Electrical World* that she had a narrow escape, and it is considered inadvisable for her to engage in further operations there, especially as the cable was found to be greatly mangled. The *Newington* was to proceed to St. Thomas for a cable to complete the repair of the St. Lucia—Grenada section.

Cape to Cairo Telegraph.—Reuter's representative at Cape Town says that according to advices received from British Central Africa, the construction of the Cape to Cairo telegraph line has reached Ujiji, and has been transferred by the Trans-Continental Telegraph Co. to the Tanganyika concession.

German-Danish Telephone.—A telephone cable is at present being laid between Berlin, Hamburg, and Copenhagen, and will, it is anticipated, be completed in the course of a couple of weeks. It is proposed later on to connect the line with Brussels and Paris.

Pacific Cable.—Reuter's correspondent at Wellington reports Sir J. G. Ward, the Acting Premier, as confirming the report that the plan of the New Zealand Government for a cable between Honolulu and Fanning Island is practically accepted.

The Pacific Cable Boards state that the long section of the Pacific Cable between Vancouver and Fanning Islands has been successfully laid, and that the cable is now in working order between the stations on these two islands. The *Anglia* is now proceeding to lay the remaining section of the cable between Fanning and Fiji. The Board trusts that the cable will be open to the public before the close of the year.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—October 31st. Condensers for electricity works. See "Official Notices" October 10th.

Batley.—October 28th. Cooling tower and tank for the electricity works. See "Official Notices" October 10th.

Bristol.—November 14th. Arc cables. See "Official Notices" to-day.

Burton-upon-Trent.—November 5th. Overhead equipment for tramways. See "Official Notices" October 17th.

Copenhagen.—November 17th. Two dynamos, switchboard, &c. See "Official Notices" October 17th.

Dartford.—November 12th. House wiring. See "Official Notices" to-day.

Dumbarton.—The U.D.C. wants proposals for the carrying out of its order. See "Official Notices" to-day.

France.—January 1st, 1903. M. Bret, Prefect of the department of Calvados, France, invites propositions for the construction of an electric tramway between Trouville and Honfleur, for passengers, parcels and goods. Length, 16 kilometres.

Halifax.—November 20th. 750-KW. steam dynamo with condenser. See "Official Notices" to-day.

Hammersmith.—October 24th. Electricity meters. See "Official Notices" October 17th.

Hornsey.—October 27th. The Council wants tenders for the fitting up of an electric light installation in its electricity works. Specifications, &c., from Mr. Robert Hammond, consulting engineer, 64, Victoria Street, S.W. Deposit, £1.

Mansfield.—October 31st. Electric wiring of the Town Hall. Specifications from Mr. Hewlett at the electricity works.

Newcastle-upon-Tyne.—November 8th. A triple-expansion direct-coupled 3,000-H.P. engine for the Corporation tramways station. Mr. A. E. Le Rossignol, general manager and engineer. Deposit for specifications, £3 3s. See "Official Notices" October 17th.

Paris.—October 27th. Competition for supply and installation of motors, pumps and generators for water-works. —Apply Hotel de Ville, Paris.

Santiago de Cuba.—November 15th. The Municipality of Santiago de Cuba is open to receive offers for installing an electric lighting system in the town.

Shanghai.—October 30th. (*a*) Two 500-KW. steam alternators; (*b*) switchboards; (*c*) two condensers and pumps. See "Official Notices" September 12th.

Southampton.—November 18th. (1) Car bodies; (2) electrical equipment and trucks. See "Official Notices" to-day.

Spain.—November 8th. The municipal authorities of Tarrega (Catalonia province) are inviting tenders until November 8th for the concession for the electric lighting of the town during a period of 15 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Tarrega (Catalonia).

St. Petersburg.—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

Sunderland.—November 28th. Steam dynamo, three-phase motor-generators and transformers, and switchboards. See "Official Notices" October 17th.

Swindon.—October 29th. Electricity meters. See "Official Notices" October 17th.

Tien-Tsin.—November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

CLOSED.

France.—The French Post and Telegraph Authorities in Paris have just given out some large contracts for copper wire as follows:—La Compagnie Française des Métaux, Paris, 50 tons, 2½ mm. diameter, at 1,679½ fr. per ton; 50 tons ditto, at 1,675 fr.; 50 tons ditto, at 1,670 fr.; 50 tons, 3 mm. diameter, at 1,654½ fr.; 50 tons ditto, at 1,630 fr. Les Trefileries du Havre, Paris, 50 tons, 2½ mm. diameter, at 1,657 fr.; 50 tons ditto, at 1,658 fr.; 50 tons ditto, at 1,659 fr.; 50 tons, 3 mm. diameter, at 1,642 fr.; 50 tons ditto, at 1,638 fr.; La Société d'Electro-Metallurgique de Dives, Paris, 50 tons, 2½ mm. diameter, at 1,665 fr.; 50 tons ditto, at 1,675 fr.; 50 tons ditto, at 1,685 fr. M. Grammont, Pont-de-Cheruy, 50 tons ditto, at 1,690 fr.; 50 tons ditto, at 1,692½ fr., and Les Forges de Franche-Comté, 50 tons ditto, at 1,630 fr.

Huddersfield.—The Electricity Committee has accepted tenders of Messrs. Callender's Co. and W. T. Glover & Co. for cables.

London.—The L.C.C. has accepted the tender of the Electric Construction Co. for the supply, for £370, of an alternator and a motor for the testing station on the Victoria Embankment.

Kirkcaldy.—The tenders of Messrs. Chamberlain and Hookham for meters at £253, and of the Schattner Electricity Meter Co. for prepayment meters, have been accepted.

Plymouth.—The T.C. has accepted the tender of Messrs. Shepstone & Co. for the overhead equipment of the Pounds section of the electric tramways, at £1,504.

Spain.—The Spanish branch of Messrs. Siemens & Halske has secured a large contract from the Sociedad Hidro-Electrica Iberica. For the Andoain station on the river Leizaran (Guipuzcoa) two 1,000-H.P. generators are to be supplied; for the Quintanamartingalindez station two sets of 2,000 H.P.; and for the Puentalarra station four sets of 1,000 H.P. each—a total of 10,000 H.P.

War Office.—The tender of Messrs. Bruce Peebles and Co. has been accepted by the War Office, Ordnance Department, for four 50-E.H.P. steam dynamos.

FORTHCOMING EVENTS.

Friday, October 24th.—At 8 p.m. Institution of Junior Engineers. Annual General Meeting at the Westminster Palace Hotel.

At 7.30 p.m.—North-East Coast Institution of Engineers and Shipbuilders. Meeting and Inaugural Address by the President.

Thursday, October 30th.—At 8 p.m. Institution of Junior Engineers. Visit to the Headquarters of the Electrical Engineering (R.E.) Volunteers. Demonstration with Searchlight Apparatus, &c.

Friday, October 31st.—At 5 p.m. Physical Society. Meeting at the rooms of the Chemical Society, Burlington House. Paper on "The Size of Atoms," by Mr. H. V. Ridout. Exhibition of "Vacuum Calorimeters," by Prof. H. L. Callendar, F.R.S.

NOTES.

Engineering Education: An American Opinion.—In the course of his recent presidential address to the American Institute of Electrical Engineers, Prof. C. F. Scott touched upon the subject of engineering education. The *Electrical World and Engineer* recalls that this also formed the topic of Mr. Steinmetz's presidential address, delivered in June last at Pittsfield, and continues: "The views of these two leaders in their profession are so similar and so completely in harmony with the thought of many educators not in direct touch with practical engineering, that they merit special attention. Mr. Steinmetz maintained that it is not the function of the schools to turn out full-fledged engineers ostensibly equipped to handle engineering problems of any magnitude; for to do this successfully a very great deal of practical experience is required which cannot be imparted by the schools. All that educational institutions can do and should do, is to fit the student to take up practical engineering work as efficiently as possible. Their true *rôle* is to give the student a thorough understanding of the fundamental principles of electrical engineering and allied science, and a good knowledge of the methods of dealing with engineering problems. He pronounced memorizing an entirely useless waste of energy, since when needed formulæ can be derived from the fundamental principles or looked up in the literature. President Scott considers the best education is that in which theoretical training in fundamental principles predominates; that the true function of practical work in a broad engineering education is not to produce skilled workmen or full-fledged engineers, but it is to supplement theoretical work, making it definite and certain, so that the student may properly assimilate the instruction which he receives. That a student should not make his mind a storehouse of facts, but he should learn where facts and information can be obtained and how to use them; that logical thinking and clear expression and general culture are indispensable in a profession that comes in touch with so many departments of science and engineering, as well as industrial and commercial and social activity; and that he must be a broad man with a broad educational foundation who would aspire, with any well-founded hope, to the fullest usefulness and success."

The Patent Law Amendment Bill.—In the House of Commons on Tuesday the Patent Law Amendment Bill, as amended by Grand Committee, was considered. An amendment moved by Mr. Whitley, to provide that the Bill should come into operation as soon as it received the Royal Assent, was agreed to. The Bill was afterwards read a third time.

Shock Fatality.—At the inquest held into the death of the electric cable jointer at Sutton Coldfield, the evidence given by Ambrose Hilleard showed that on Friday, October 3rd, he and deceased (James Jones, aged 27) were making some alterations to some dead cables at a street box. He had occasion to tell deceased to go to the other side of the box and pull the cable up from the bottom to enable him to box the end of it. Deceased did so, and after witness had completed his work he told deceased to let the cable go. Immediately witness heard a peculiar hissing noise and a moan. He looked through the cables and saw blood on deceased's nose. He went round to deceased and found him kneeling down on the ground with his face on a live connection. Deceased was taken into Dr. Frazer's surgery opposite. Witness believed deceased must have fallen on to the bus-bar, and he was surprised that the voltage, which was only at 230, should have killed him. Witness himself touched the bus-bar on which deceased fell, and it only made him jump. Dr. Frazer said that, on examining the body, he found on the left side of the nose a small wound, and on the left cheek, from the lip towards the left eye, signs of burning. It was impossible for him to say whether deceased died from paralysis produced by the electrical shock, or whether he might, through an attack of syncope, have fallen on to the bar and met the connection. Dr. T. Betteridge, of Sutton Coldfield, who, in conjunction with Dr. W. F. Cholmeley, of Wolverhampton, had made a *post-mortem* examination of the body, stated that there was evidence of disease of the heart, and that deceased might be subject to attacks of syncope and giddiness. In his opinion, the electric shock, combined with the weakness of the heart, caused the death of the deceased. Mr. Trevor Duesbury, electrical engineer, in the employ of the Corporation, said that at the time of the accident the voltage was 235. Current at such a pressure could not produce death. He believed deceased must have been attacked with giddiness, and have fallen forward on the bus-bar. The jury considered deceased died from an electric shock owing to having a weak heart, and they thought the Callender Co. should provide rubber mats for their employés when they were engaged in such dangerous work.

The British Westinghouse Co.'s Works at Manchester.—The Manchester Association of Engineers, which has just opened its winter session, paid a visit a few days ago to the electrical engineering works of the British Westinghouse Co. in Trafford Park. The members were received and shown over the establishment by Mr. Lord, the general manager. The works, covering about 130 acres of ground, are rectangular in plan, and their construction absorbed 15,000 tons of English-made steel, 10 million ft. of timber, 11 million bricks, and 50,000 yds. of concrete. They comprise an iron foundry, brass and malleable iron departments, pattern shop and stores, steel foundry and forge, electrical power generating station, machine shop, &c. Wherever possible electric power is used to accelerate production and reduce cost. The machine shop contains, it is believed, the largest machine appliances (including a 28 ft. boring mill) to be found in this country. All the power is derived from electric motors. Portable electrically-driven tools are used. Electric cranes, each capable of lifting a weight of 50 tons, traverse the main aisle, and 25 miles of railway line form a network of communication throughout this works. The administrative offices occupy a building six storeys high. Employment is at present given to 2,000 men. This number will be trebled when all the departments are in full operation. The principal contracts in progress at the time of this visit included dynamo machinery of 1,500 H.P. for the Swansea Corporation, machinery for the New Zealand Electrical Syndicate, the Birmingham Small Arms Co., the London United Tramways, the South Wales Power Distribution Co., and the Clyde Valley power scheme generating stations. Other important work for various manufacturing firms throughout the country is also being carried out. The President of the Society, speaking at a meeting subsequently held, remarked that if the Westinghouse Co. was successful in its new system of labour, English employers would be compelled to look into the matter, and the result would be a general levelling up not only in methods of work, but in the class of workmen engaged in the engineering trade. Individual firms might suffer, but the trade, as a whole, would be benefitted.—Mr. Thomas Ashbury said this invasion of American enterprise would tend to improve engineering practice generally, and Manchester, in particular, would benefit by the developments now taking place.

Yorkshire College Engineering Society.—On Monday, October 13th, at Leeds, Prof. Goodman delivered the presidential address to the members of the above society, taking for his subject "Engineering in Canada and the United States." During a three months' tour he and four students had visited many large works. The prospects for young, technically-trained engineers were stated to be very good, Victoria, British Columbia, being especially mentioned as a favourable field for mining engineers.

Obituary.—We learn with profound regret of the death of Prof. Sidney H. Short, of the English Electric Manufacturing Co., which occurred on Tuesday, of appendicitis, at 4, Whitehall Court, S.W. The late Mr. Short, who came to this country several years ago, was very highly esteemed in electrical circles here. He was only 44 years of age.

We learn with great regret of the death of Mr. John Imray, the well-known consulting engineer and patent agent, which occurred on September 29th, in his 82nd year. He came to London from Aberdeenshire when only 17 years of age, and became a pupil at the works of Messrs. Maudslay, Sons & Field. About 1845 he was making railway surveys in connection with the then current railway mania. In the 1862 Exhibition he exhibited several steam engines and also a steam hammer which he had

invented. From 1864 he commenced to act professionally as adviser and expert in law cases connected with patents and machinery, and about this time he wrote a treatise on practical mechanics and the steam engine, which formed part of Orr's circle of the Sciences. In 1867 he gave up his engineering business at Lambeth and started as consulting engineer and patent agent in Great George Street, Westminster. In conjunction with Mr. R. Richardson, C.E., he prepared plans for a canal to bring a supply of sea water to London and for the formation of a light overhead railway from Islington to the City. For some time he took the leading part in an institute called the Inventors' Institute, and acted as editor of the *Scientific Review*, and as such editor, took a leading part in the controversy between Prof. Wheatstone and W. Fothergill Cooke as to who really invented the electric telegraph, and it is believed that, in consequence of his endeavours, Cooke also received the honour of knighthood. In the year 1871 he joined Mr. Abel (brother of the late Sir Frederick Abel) in partnership as consulting engineers and patent agents, in which business he took a very active part until a fortnight before his death. For many years he was employed as an expert in most cases of patent litigation, and among the principal cases may be mentioned the Telephone actions, the Otto Gas Engine actions, the Westinghouse Brake actions, Railway Signalling actions, and the Welsbach Gas Lighting actions. In the year 1882 the Institute of Patent Agents was formed, when he was elected vice-president, and the succeeding year was elected president, and devoted a considerable time to the successful formation of this Institute, and the obtaining of its Royal Charter. He was also a member of the Institution of Civil Engineers, of the Institution of Mechanical Engineers, and of the Royal Institution.

Automobiles in War Service.—*Cassier's Magazine* prints an article on this important subject from the pen of Brigadier-General Macdonald. From this article the layman may get a glimpse of the enormous importance of transport in war. A large army, especially if it employs horse transport, has enormous baggage trains. If horses were eliminated, a baggage train would not exceed a third of its present length. Not merely in bulk is the train less, but its speed is greater, fully double that of an animal-drawn train. Traction engines cannot be cruelly treated, and though South Africa was full of enteric-breeding dead animals, there was no dead engine. An instance from the General's own experience is that of a line of steam traction from Pretoria to Rustenburg required to carry 130 tons of food per week to two columns 20 or 30 miles west of Pretoria. Of that load about 30 tons were for men and 100 tons were for animals, and in place of the latter about 8 tons of fuel would have sufficed. All heavy things could be carried by self-propelled steam or oil vehicles. We presume even the mess piano could be so carried. The General prefers oil to steam, because steam is visible so far away, and, moreover, water is not always sufficiently available for steam work. Lord Roberts always sent for traction engines to move heavy guns into position. In South Africa it always proved that where the British could move away from the line of railway the Boers were forced to retreat promptly or were disastrously outflanked. War brings into prominence all the bad qualities of animal traction, and there can be no doubt that the cruelties to animals are abnormally and unavoidably magnified to a distressing degree, with an even worse result to the men. The moral drawn is that mechanical traction is practically a necessity.

The Steam Turbine.—At the Walker Engineering Laboratories of University College, Liverpool, on Tuesday last week, Prof. Hele-Shaw delivered an address on "Steam Turbines," sketching their history and development. In seconding a vote of thanks to the Professor, Mr. Shield (formerly chairman of the Walker Engineering Laboratories Committee), according to the *Times* report, said he had only just returned from the Continent, where steam turbines excited deep and universal attention. There was scarcely a steam engine maker who was not seriously considering that question, and what had brought about that state of things was the fact that in all recent tenders of any importance for electrical plant steam turbine makers had not only tendered below the price of the best makers of reciprocating engines, but had guaranteed an economy which the makers of reciprocating engines could not possibly get. In Paris wonderful results were being achieved, and the makers were working in a way which he thought would render the adoption of turbines easier than at present, because, by the expedient of having each separate ring of guide blades and vanes encased in a separate chamber, less accuracy of fitting was necessary, as the steam was compelled, after escaping into its own chamber, to pass into the next chamber and there do the work. This, he thought, would greatly reduce the cost of turbines, and possibly bring about their universal adoption.

Personal.—It is announced that Mr. C. S. Drummond has resigned his seat at the board of the British Electric Traction Co., owing to his having accepted the chairmanship of two American companies, necessitating his frequent absence from England.

Mr. T. Coast, chargeman of electrical fitters at H.M. Dockyard, Chatham, has been appointed inspector at Malta Dockyard.

Mr. F. R. Markham, who is leaving the Arc Works, Chelmsford (Messrs. Crompton & Co., Ltd.), where for 11 years he has had charge of the test department, has been presented by the staff with a silver inkstand, pair of field glasses, and an illuminated address. Mr. Markham is leaving to join the new business at Walthamstow of Messrs. Bray, Markham & Priess.

The New Technical Institute at Manchester.—At the opening of this great Institution last week, the Lord Mayor, in a brief address, mentioned the fact that Manchester was the second borough in England to take advantage of the Technical Instruction Act. It did this before anything was heard of the "whisky money," having levied a rate for the purpose. The City Council had always supported the efforts of the Committee most generously. It had given them everything asked for, and any credit attaching to the foundation of the school must be shared by the Corporation as a whole.

Mr. Balfour, in his address, spoke of the Manchester Technological School as the greatest fruit of municipal enterprise in this country, and though he could have no adequate idea, from his present visit, of all that it was capable of doing for the industries of Lancashire, still nobody could go over the building, observe its equipment, study, even in the most cursory manner, the care that had been devoted to it, without feeling that the Corporation had set a great example worthy of the place the city held in Lancashire and in Great Britain. He recalled with pride the fact that he was a member of the Administration which, in 1889, formed the first Technical Instruction Act. The great building in which they were assembled was an outward and visible sign of that awakening which had come over our people in view of the ever-changing conditions of international industry. There was a time when we could flatter ourselves, without any undue egotism, that not only were we first among industrial nations, but that the rest were nowhere. That time had passed, never to return; and he was far from uttering any selfish complaints regarding the changed conditions, which were, indeed, inevitable. The growth of the world's wealth must be a benefit to every part of the world, and all we had to do was to bear our share in the great industrial development. But there has also been another change—a change from the pre-scientific to the scientific stage of industry. When England obtained its manufacturing monopoly the relation between science and industry was of the feeblest character. The intimate correlation between the discoveries of the laboratory and the processes of the workshop was not in existence; hence it happened that, in some branches of work, we were behind our neighbours, who, in this respect, though not in many others, had proved themselves more apt to learn that lesson than we had ourselves. Foreign nations had grasped more firmly than we had the great truth, on which he insisted, that, in order to profit by a scientific training—to turn the learning acquired to purposes of original discovery—a pupil must come thoroughly prepared, anxious and ready to learn. He must have a sound preliminary training in the ordinary branches of education. Much, however, depended on the manufacturers. It was quite useless to turn out highly trained and capable students if there were no employers for them. He did not know whether in Germany, for instance, this had not been overdone. It would be impossible—speaking from what he knew of a few years ago—to go into any German manufacturing establishment, electrical, chemical, or other, without finding a proportion of scientifically trained assistants enormously in excess of anything that was commonly thought necessary in this country. True theory and true practice could never be divorced without loss to both. In the changed and ever-changing conditions of our time we should imitate the best qualities of our forefathers—their energy, their anxiety to take the best the world had to give—and their institutions, like the Manchester Municipal School, would bear for that city and the country at large, all the fruit of which they were capable.

On the motion of the Earl of Derby, a vote of thanks was given to Mr. Balfour for his address.

Several other speeches followed; and in the evening a conversazione was held in the new school building. The various departments were thrown open and experiments were conducted by the Professors in the electricity, engineering and chemical laboratories.

The Italian Electro-Technical Association.—We have received a copy of the programme of the general meeting of the Italian Electro-Technical Association (Associazione Elettrotecnica Italiana) which is to be held in Turin from the 31st inst., to November 3rd. The papers to be read on Friday, the 31st inst. include one by Prof. Angelo Banti on "The Behaviour of Rotary Converters in Electric Traction Installations with Stationary Accumulators," and one by Signor Domenico Civita on "Electric Traction on Railways." Prof. Guido Grassi will give two papers:—One on "Dynamo and Alternator Calculations," and one on "Some Properties of Transformers." On the same day the Committee on "Units of Measurement" will present a report. On Saturday the 1st prox. Signor Giovanni Giorgi is to present a paper on "The Basis of the Theory of Electrical Intensities," and another on "The Action of the Ruhmkorff Coil," while Signor Ciaretti will deal with the subject of "The Electrolytical Purification of Beet Sugar," and Signor Secondo Sacerdote with "Variations of Current and their Applications." Sunday, November 2nd, and Monday, November 3rd will be devoted to a visit to the Exhibition of Modern Decorative Art, in Turin, and to a number of electric power plants in the district.

Appointments Vacant.—Ilford U.D.C. requires a general and traffic manager for the trams at £250; an assistant is wanted at Falkirk at £100; a resident engineer is wanted for Hastings at £300. See "Official Notices" to-day.

Tube Railways.—The Tube Railway Committee resumed its sittings on Tuesday, when it was announced that the London United Electric Railways Scheme had been withdrawn. Our account of the proceedings will appear in our next issue.

The M.E.S. and Marylebone Arbitration.—The arbitration proceedings in this matter were resumed on Monday last. Our report is held over until next week.

For Sale.—On November 3rd, Messrs. P. Huddleston and Co. will sell by auction at Manchester a quantity of electrical plant (Moon, Loughlin & Co. in liquidation), of which details appear in our advertisement pages to-day.

Electricity in Agriculture: An Austrian Installation.—The *Zeitschrift für Elecktrotechniker* for August 31st contained an illustrated description by Herr Roth of an Austrian farm whereon electricity is employed for ploughing and also for driving a pump and an agricultural machine, and we find a brief account thereof in the *Electrical World's* excellent digest. The pump and agricultural machine are only working at long intervals, and they are therefore placed on the lighting circuit, but for ploughing a separate circuit is used. There is a small water-power available, giving 500 litres per second at a height of 8 metres; a 40-H.P. turbine is used, running at 275 r.p.m. To improve the uniformity of revolution, a 1,000-kg. fly-wheel is mounted on the shaft of the turbine. With the turbine are connected two sets, each consisting of two electric machines. The larger set is a 65-KW., 2,100-volt, three-phase alternator and a 40-KW., 110-volt, direct-current dynamo, while the smaller set is a 10 KW., 2,100-volt, three-phase alternator and an 11-KW., 110-volt, direct-current dynamo. There is also a battery of accumulators of 60 cells, giving 987 ampere-hours in seven hours. The 65-KW three-phase machine gives the current for ploughing, the 10-KW. three-phase machine for lighting. While current is used for ploughing, the 65-KW. three-phase machine is coupled with the 40-KW. direct-current machine, and the latter is connected with the storage battery. As long as the whole power is not required for ploughing, the battery is charged from the direct-current machine. When more power is required for ploughing than the turbine can give, the battery drives the direct-current machine, which then runs as a motor and supports the turbine. If during ploughing current is required for lighting, the smaller machine set is used, which, however, is then disconnected from the turbine, in order to avoid fluctuations of the light, due to sudden changes of the ploughing load; the 11-KW. direct-current machine is then driven as a motor from the battery, and drives the 10 KW. three-phase machine, which gives the lighting current. When the ploughing is finished, the 10-KW. three-phase machine and either of the two direct-current machines are driven by the turbine; the former gives the current for lighting, the latter for charging the battery. For ploughing the following system is used:—At one side of the field is placed the car with the motor, which drives a steel rope along which the plough is running. The speed can be reduced to 10 per cent. of full speed by means of a regulating resistance. The steel rope runs from the car with the motor to another car at the other side of the field and back. The progress from one furrow to the next takes place nearly automatically by means of only two switches. The installation is said to work very satisfactorily.

A Third-Rail Problem.—"It is very curious that a tunnel third-rail contact carrying a heavy current requires to be used under heavy electric load, in order to operate sparklessly. Such is the undoubted fact. A third-rail unused for 48 hours sparks and sputters for the first few trips, and then settles down to satisfactory operation. This would naturally be accounted for by the presumption that rust and foreign material had accumulated and were thus removed, and even if the rail appeared bright, at the beginning of the experiment, one would be still inclined to adhere to this idea. A third-rail engineer, however, contributes this piece of information, which certainly gives rise to some further speculation: A tunnel is equipped with two tracks and two third-rails. Regular service demands that the locomotives pull heavy trains over one track and return light over the other. Both third rails obviously get equal mechanical cleaning. In fact, they look clean and exactly alike, yet when, through some exigency of traffic, the locomotive is required to pull a load over the tracks on which it commonly operates light, the attempt is accompanied by most formidable sparks and arcs which do not cease till repeated heavy trips have been made. It is not a matter of shoes, because the locomotive in question has ample opportunity, in its regular work, to use all of its shoes under heavy load. This would seem to indicate some curious virtue imparted to the third-rail by the heavy current-carrying shoe and not by an idle shoe. Simple inspection does not suffice to explain the phenomenon, and complex investigation is yet to be heard from."—*Street Railway Journal*, Chicago.

THE CENTRAL STATION ENGINEER.

The Heywood T.C. has appointed Mr. J. Stott as resident electrical engineer, in succession to Mr. W. S. Johnston.

The staff at the Plymouth Corporation electricity works on October 15th presented a number of books to Mr. T. R. Stancombe, who is leaving to take up the position of charge engineer at Wimbledon.

On Tuesday, October 14th, a smoking concert was held by the staff and employés of the Paisley Electricity Works, Mr. S. H. Rhodes, chief assistant engineer, being in the chair. During the evening a marble timepiece was presented to Mr. J. M. Barbour, chief clerk, on the occasion of his marriage.

NEW COMPANIES REGISTERED.

Siemens Electric Appliances, Ltd. (75,102).—This company was registered on October 13th, with a capital of £25,000 in £100 shares, to carry on the business of manufacturers of and dealers in electrical goods, appliances fittings, apparatus, engines, plant, machinery, tools, materials and things electricans, engineers, manufacturers, contractors, suppliers of electricity to light, heat, motive power and other purposes, manufacturers of cables, wires lines, accumulators, lamps, fittings and accessories, &c. The first subscribers (each with one share) are:—G. von Chauvin, 12, Queen Anne's Gate, S.W. telegraph engineer; F. A. Spiecker, Meine Westrasse, 22, Berlin, merchant J. J. Easton, Inglewood, Sutton, Surrey, telegraph engineer; A. Sabine Grasmead, Dulwich, secretary; A. M. Hicks, 12, Belmont Road, Wallington, Surrey, clerk; A. Straube, Fern Bank, East Heath Road, Hampstead, telegraph engineer; A. Siemens, Coombe House, Kingston-on-Thames, and T. Lawrence, 16, Duncan Road, Richmond, clerk. No inital public issue. The number of directors is not to be less than two nor more than five: the first are G. von Chauvin (chairman), F. A. Spiecker, Dr. W. Howe and J. J. Easton; qualification, £1,000.

Electromobile Co., Ltd. (75,139).—This company was registered on October 17th, with a capital of £50,000 in £1 shares (5,000 deferred) to manufacture or cause to be manufactured, buy, hire, sell, let on hire and deal in motor cars and motor carriages and their components, fittings and accessories, to carry on the business of automobile, store and garage keepers, suppliers of electricity and motive power, &c., and to adopt agreements (1) with the British Electromobile Co., Ltd.; (2) with the Gloucester Railway Carriage and Wagon Co., Ltd.; (3) with Greenwood & Batley, Ltd.; (4) with T. G. Chambers; and (5 and 6) with T. H. Weguelin and E. Schenk. The first subscribers are:—T. G. Weguelin, Bartholomew House, Bartholomew Lane, E.C., with 250 shares; E. Schenk, 20, Victoria Street, S.W., chairman of Crystal Palace Co., with 250 shares; T. G. Chambers, 4, Bloomsbury Place, W.C., engineer, with 250 shares; G. Wilson, Arrandale, Adamcrill Road, Sydenham, S.E., clerk, with 1 share; L. Bulliel, Bartholomew House, Bartholomew Lane, E.C., stockbroker, with 1 share; H. Carr, 9, Cambridge Street, Hyde Park, W., clerk, with 1 share; and A. Smith, 77, Gascony Avenue, West Hampstead, clerk, with 1 share. Minimum cash subscription 10,000 ordinary shares. The first directors are T. H. Weguelin, E. Schenk and T. G. Chambers, managing director; qualification, 200 ordinary shares; remuneration (except managing director) as fixed by the company. Registered office, 4, Bloomsbury Place, W.C.

Electric Traction Insurance Association, Ltd. (75,138).—This company was registered on October 17th, with 100 members, each liable for £1 in the event of winding-up, to insure on the mutual principle against claims, losses and damages in respect of accidents caused by electric tramcars or tramways in which members of the company are interested, and to carry on (as a separate business) insurance on the mutual principle against claims and losses arising under common law, or under the Employers' Lisbility Act, 1880, the Workmen's Compensation Act, 1897, or other Acts in respect of fatal or other accidents to persons employed in connection with electric tramways. The first subscribers are:—P. G. H. Carvill, 29, Morpeth Mansions, S.W., barrister; H. L. Jefferson, Lloyd's, E.C., underwriter; W. Higgins, 5, King's Bench Walk, Temple, E.C., barrister; C. G. Hentsch, Lloyd's, E.C., underwriter; J. F. Albright, Oldbury, near Birmingham, civil engineer; G. T. Brodrick, Lloyd's, E.C., underwriter; and A. W. Johanning, Suffolk House, Cannon Street, E.C., secretary. The subscribers are to appoint the first directors; remuneration, £110 each per annum and £200 for the chairman.

Burmah Electric Tramways and Lighting Co., Ltd. (75,090).—This company was registered on October 11th, with a capital of £200 000 in £5 shares, to construct, equip and work as owners, lessees, managers and contractors, any tramways, light railways, or other roads or ways, to generate, supply, utilise and distribute electric or other power for locomotion, for the working of plant or machinery, for heating or lighting, for telegraphic or telephonic purposes or otherwise, and to undertake any other business which can be conveniently carried on in connection with the above. The first subscribers (each with one share) are:—C. R. Webb, Worcester House, Walbrook, E.C., chartered accountant; P. Phipps, 29, Selby Road, Anerley, S.E., gentleman; N. W. Leathers, 9, Christchurch Road, Crouch End, N., clerk; H. E. Sherreard, 313, Finchley Road, S. Hampstead, N.W., clerk; L. A. Baddley, Whitehall, Chingford, chartered accountant; W. R. Elston, Worcester House, Walbrook, secretary; and W. J. Simpson, 25, Plaine Grove, Gospel Oak, N.W., clerk. Minimum cash subscription, 100 shares; the number of directors is not to be less than three nor more than five; the first are E. C. Morgan, 20, Sussex Mansions, S. Kensington, S.W.; C. B. Pritchard, 2, Charles Street, Mayfair, S.W.; F. C. Kennedy, 15, St. Vincent Street, Glasgow; D. C. Ellis, 36, Basinghall Street, E.C.; and H. B. Kindersley, 8, Stone Buildings, Lincoln's Inn, W.C.; qualification, £100; remuneration, £150 each per annum (chairman £300, vice-chairman £200). Registered office, Worcester House, Walbrook, E.C.

Accumulator and Motor Construction Co., Ltd. (75,134).—This company was registered on October 17th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, engineers, manufacturers of and dealers in motors and accumulators of all kinds, suppliers of electricity for light, heat, power and other purposes, &c. The first subscribers (each with one share) are:—F. Godelmann, 48, Parliament Hill, Hampstead, general merchant; G. H. Mackay, 48, Parliament Hill, Hampstead, manufacturers' agent; W. Norris, 38, Compton Road, Highbury, N., general agent; R. Taylor, 282, High Holborn, W.C., surveyor; D. W. Drummond, 45, Parliament Street, S.W., solicitor; Miss M. Drummond, 23, Grove Terrace, Highgate Road, N.W.; and J. K. Mackay, 48, Parliament Hill, Hampstead, N.W., secretary. No initial public issue. The number of directors is not to be less than two nor more than three; the first are F. Godelmann and J. K. Mackay. Registered office, 282, High Holborn, W.C.

CITY NOTES.

Edmundson's Electricity Corporation, Ltd.

An extraordinary general meeting was held on Thursday, last week, at the offices, Broad Sanctuary Chambers, Westminster, to consider resolutions for increasing the capital.

Mr. F. E. Gripper presided, and, in explaining the reasons for adding to the capital, said, according to a report in the *Times*, that their principal business was really that of an electric supply company, and they now had 20 central stations working in which they had the controlling interest. Additions had to be made, from time

to time, to the generating machinery, as well as extensions to the mains, in order to meet the growing demands of customers. It was to provide for such extensions that further money was wanted, and it would be profitably employed in carrying out such work. The directors were well satisfied with the progress which was being made at the various stations. The policy of the board was to retain the company's investments in these undertakings until they had been thoroughly developed and had reached their full value. This, of course, called for large funds, but the policy was undoubtedly the right one. Already many of their investments could be realised at a considerable profit, but it was expected that they would become much more valuable within a comparatively short time. It was not intended to issue more than £100,000 of the new capital at present. The balance would be retained for issue as and when required. He then moved resolutions for increasing the capital to £600,000 by the creation of 40,000 new shares of £5 each, and authorising the board to issue preference or ordinary shares, as they might think fit, subject to the condition that the aggregate amount in nominal value of the whole of the preference shares of the company for the time being should never exceed the aggregate amount in nominal value of the ordinary shares issued.

Mr. W. R. Davies, in seconding the resolutions, said that the proposed additions to the central stations would be very profitable, and the new capital would certainly be advantageous to the undertaking as a whole.

The resolutions were carried unanimously

Richardsons, Westgarth & Co.

The report for the year ended August 25th last, states that the profits, after fully providing for maintenance of plant, amount to £93,961, to which has to be added the balance brought forward, £7,062—£101,023—out of which there has been appropriated for various purposes £44,679, leaving a balance unappropriated of £56,344, which the directors recommend should be dealt with as follows:—Dividend on preference shares at 6 per cent. per annum from May 1st to August 25th, 1902, accrued, £6,653; dividend on ordinary shares at 6 per cent. per annum for half-year ended August 25th, 1902, £10,500; set aside for depreciation, £15,000; carried to reserve account, £10,000; written off preliminary expenses, £3,576; carried forward, £10,615.

Electrolytic Alkali Co.

The report for the year ended August 31st last, to be presented to the meeting in Middlewich on the 30th inst., states that the net profit for the year, after expenditure in keeping the plant, machinery and tools in a state of efficiency, allowing for depreciation and interest on calls paid in advance, but without providing for directors' remuneration, is £6,420. To this has to be added the amount brought forward from the last account, £1,242, making an available balance of £7,662. The directors propose that this amount be applied in paying the cumulative dividend on amounts called up on the preference shares issued to date, calculated from the several dates of payment of instalments, to August 31st last. This will absorb £7,331, and leave £331 to be carried forward to the next account. There are now two units of plant in operation, and both are working satisfactorily. The second unit was, however, only started early in August last, so that one unit has practically earned the whole of the preference dividend. During the year 100,000 additional shares (50,000 of each class) were offered for public subscription, and the whole of these were applied for and duly allotted. The preference shares were considerably over-subscribed. The process continues to work well, and the excellence of the products commands a ready market for them. The demand for the company's make of bleaching powder is very good, and the present plant is taxed to its utmost capacity. The requirements of the company have necessitated the provision of more convenient offices, and these are now in course of erection.

Western Telegraph Co., Ltd.—The directors have, after transferring £30,000 to the general reserve fund, and £2,000 to the maintenance-ships' reserve fund, decided to recommend a final dividend of 3s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended June 30th, 1902, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account is carried forward. For the purpose of paying the above dividend and bonus on the 30th inst., the register of transfers will be closed from October 22nd to 29th, both days inclusive.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in Calcutta Electric Supply Corporation, Ltd., further issue of 20,000 shares of £5 each; and to allow the following to be quoted in the Official List:—Colombo Electric Tramways and Lighting Co., Ltd., £120,000 5 per cent. first mortgage debenture stock.

Oriental Telephone and Electric Co.—The directors have declared an interim dividend of 2½ per cent. on the paid-up capital. The warrants will be posted on 31st inst.

Globe Telegraph and Trust Co.—The directors announce a quarterly interim dividend of 1s. 9d. per share on the ordinary shares.

STOCKS AND SHARES.

Wednesday Evening.

Politics continue to lead finance by the hand, and prices waited during the early part of the week upon Mr. Chamberlain's postponed statement in reference to the taxation of the new Colonies and to the coming Loan. More interest was taken in this pronouncement than in the Royal Progress, and it is well for markets, investment and speculative alike, that the uncertainty is terminated by a statement of the Government's intentions

Business in electric descriptions continues good, and in comparison with the inanimation prevailing in other departments of the Stock Exchange, there is little to grumble at. Of course the comparative dulness of Consols and gilt-edged securities generally does affect such a purely investment market, as is that for Electrical Supply shares, to a certain degree. Fluctuations are infrequent, but there are more changes to be found in the telegraph section. The railway department commands a fair share of business, and traction enterprises remain in good favour.

Thanks to the battle of the "Tube" promoters before Sir Lewis McIver's Committee, Metropolitan and Metropolitan District stocks have moved up sharply, the market arguing that the withdrawal of the London United Railways Bill should leave the ground clearer for the two Sewer companies. Districts advanced to 38½, Metropolitan Consolidated to 83¾, but of the Tube securities only Central London Deferred shared in the movement. It is a somewhat remarkable thing that, packed as the Central London trains are in the morning, the District Co. also manages to fill its carriages to overflowing, and between certain hours in the morning it is difficult to get a seat except at a station near the commencement of the journey. Waterloo and City stock is better upon the changes in the directorate of the London and South-Western, referred to here last week. The improvement, however, does not go further than a point. Great Northern and City Preferred "A" shares are £8 middle, and judging from the look of the preparations at Finsbury Park station, the time for opening the line should not be delayed many months now.

London United Tramways issues are all the same prices as quoted last week, nor has any change occurred in British Electric Traction shares, the *Times* and the *Daily News* controversy notwithstanding. Calcutta Tramways Ordinary shares are receiving a good deal of attention just now, the price being about 7⅛, while the Preference are 4½, and the 4½ per cent. First Debenture stock 108½. Buenos Ayres and Belgrano Second Debenture changes hands in the neighbourhood of par, but the company's other varieties are somewhat neglected. Anglo-Argentines keep hard at 4½, and Barcelona Trams are 10. South London Electric Supply shares hardened ¼ upon the company's report that it has sold 110,000 more units during the first nine months of this year than it did in the corresponding period of 1901, and the gross revenue is £2,300 better. City of London Ordinary and Preference have also improved, the extent of the rise being 10s. in each case, while the Second Debenture stock is up 1 per cent. This security was specially singled out for suggestion as likely to be an improving investment some months ago, when the price was about par; it seems quite good enough to hold at its present level, and will probably score another quiet advance. County of London Debenture is the turn easier.

No change has taken place in Globe Telegraph and Trust upon the declaration of the usual quarterly dividend on both classes of shares, but the Preference are in demand on behalf of investors, and seem likely to go better when the present tyranny of the money market is overpast. Most of the changes produced in the Telegraph section are by reason of the marking of prices *ex* dividend on the last account day, October 15th. In the majority of cases the deduction has been nearly or fully recovered. Eastern Extension shares, for instance, show no trace of having lost 2s. 6d. for dividend; Anglo-American Telegraph Ordinary stock is also unchanged, and the "B" is better, allowing for the 1½ per cent. deducted. West Coast of America shares are quoted nothing to 5s.

National Telephone Deferred stock exhibits a better tone, otherwise Telephone descriptions are unaltered. Telegraph Constructions have fallen £1, and Brush Ordinary are again ¼ off, Electric Construction Preference being lower to the same extent. The Electrolytic Alkali directors have a balance of £7,662 to deal with, and propose to pay 7 per cent. on the Preference shares, the price of which is about 1, while the Ordinary are an eighth lower.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Oct. 15th.	Closing Quotations Oct. 22nd.	Business done week ended Oct. 22nd, 1902. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	73/6	3¼%	61s.	48 — 51	48 — 51 xd	50	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	91 — 93	92⅞	92
3,105,580	Do. do. do. Deferred	Stock	£1 7s.	5s. %	2s.	7½ — 7⅞	7⅜ — 8	7⅞	7⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3⅝ — 4	3⅝ — 4⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	160 —170	160 —170 xd	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock				94 — 96	94 — 96	96	94½
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5⅛ — 6⅛	5⅛ — 6⅛	5⅞	..
6,000	Do. 10 % Pref.	10				13 — 14	13 — 14	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2⅝ — 3⅛ xd	2⅝ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5				7 — 8 xd	7 — 8	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½ — 11	10⅜ — 11 xd	10⅝	..
96,300	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100				100 —103	100 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	125 —130	124 —129 xd	127	124½
1,955,565	Do. 3½ % Pref. Stock	100				90 — 93	89 — 92	90½	90
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock				106 —109	106 —109	107⅛	106½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½ xd	12⅛	12⅛
320,000£	Do. 4 % Deb. Stock	Stock				107 —110	107 —110	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	5½%	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25				101 —104 %	101 —104 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9⅜ — 10	9⅜ — 10	9⅞	9⅞
180,042	Do. do. 6 % Pref.	10				13¼ — 14	13¼ — 14	13⅛	..
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	15 %	27 — 28	27 — 28	..	..
70,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100				100 —103	100 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100				101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	..	..	⅛ — ¼	⅛ — ¼	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %			½ — 1	½ — 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	93 — 95	93 — 95	94	93
1,966,667	Do. do. Def. Stock	100	..	60	64 xd	55 — 57	56 — 58	56⅝	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½ — 13½	12⅜ — 13½	13⅜	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½ — 12½	11½ — 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4½ — 5⅛	4½ — 5⅛	5	..
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	..	4 %	4 %	102 —106	102 —106	104	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	⅞ — 1	⅞ — 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	99 —102	99 —102	..	..
11,839	Reuter's	8	5 %	5 %	5 %	6½ — 7½	6½ — 7½ xd	7⅛	..
3,303	Submarine Cables Trust	Cert.				110 —120	110 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5				4⅜ — 5	4⅜ — 5	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3⅛ — 4⅛	3⅛ — 4⅛	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	⅜ — ⅝	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —101	98 —101	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	11½ — 12½	11½ — 12½	12⅛	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	102 —105	102 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100				99 —102	99 —102	..	..
88,321	West India and Panama Telegraph	10	⅝%	1%	..	¼ — ⅜	¼ — ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4⅛ — 5	4⅛ — 5	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 — 103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	5¼%	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..
300,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock				83 — 88	83 — 88	..	..
100,000	British Electric Traction	10	8 %	9 %	9 %	13 — 14	13 — 14	13⅜	13½
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12½ — 13	12½ — 13	12⅝	12⅞
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock				124 —127	124 —127	126	125½
100,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7⅞ — 8¼	7⅞ — 8¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞ — 6	5⅞ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	103 —106	..	..
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	..	8 %	..	13s. to 15s.	13s. to 15s.	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	6 %	..	16s. to 16/6	16s. to 16/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5½%	5 %	Nil	¾ — 1⅛	1 — 1⅛	1⅛	1⅛
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1 — 1⅛	1⅛ — 1⅜	1⅛	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock				94 — 99	93 — 98	..	..
35,000	Callender's Cable Construction shares	5	15 %	15 %	20 %	15½ — 16½	15½ — 16½	15½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅝ — 6¼	5⅝ — 6¼	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	109 —113	109 —113	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	..	4 %	104 —107	108 —111	107	105½
494,093	Do. do. 4 % Pref. Stock	Stock	..	..	4 %	107 —110	107 —110	108½	108½
494,993	Do. do. Def. do.	Stock			4 %	105 —108	108 —111	106½	..
1,330,000	City and South London Railway	Stock	1⅞%	1⅞%	2 %	71 — 73	71 — 73	72⅜	73½
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	8 %	7½%	2½ — 2⅝	2⅜ — 2⅝	2⅝	2⅝
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —106 %	101 —106 %	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	6 %	2½%	..	⅜ — ⅝	⅜ — ⅝	..	..
17,139	Do. do. "A" shares, 01—017,139	5	6 %	2½%	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 78	74 — 78	..	..
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100				77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝ — 2	1⅝ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅛ — 3	2⅛ — 2⅞	..	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	..	5 %	5 %	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock				99 —102	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅛	16⅛
35,000	Do. do. 4½ % Pref.	5	4½%	4½%	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock				109 —113	109 —113	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	20½ — 21½	20½ — 21½	..	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¾%	1¼%	4⅜ — 5	4⅛ — 5⅛	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	..	..	10 — 10½	10 — 10½	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14½ — 15½	14½ — 15½	..	..
	§Rosling & Fynn 6 % Cum. Pref.	£1	..	6 %	..	19/0 to 20/0	.. — ..	..	..
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	38 — 41	37 — 40	39½	38
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	102 —105	102 —105	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 95	91 — 94	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
§ From Bradford Share List. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, ¾—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 12—14.
Do. do. Pref. (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Oct. 15th.	Closing Quotations Oct 22nd.	Business done week ended Oct. 22nd, 1902. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	⅜ — ½	⅜ — ½	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100				105 —108	105 —108		
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	6 %	8 %	10⅜— 10⅝	10⅜— 10⅝	10⅜	
20,000	Do. do. 7 % Cum. Pref.	5				10⅜— 10⅝	10⅜— 10⅝		
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9¼	9 — 9¼	9⅞	9¼
70,000	Do. do. do. 4½% Cum. Pref.	5				5⅜— 6	5⅜— 6	5 31/32	
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5				4⅞— 5⅛	4⅞— 5⅛		
250,000	Do. do. 4 % Deb. Stock Red.	100				105 —107	105 —107		
44,436	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5⅜— 6	5⅜— 6		
150,000£	Do. do. % Deb. Stock Red.	Stock				109 —112	109 —112		
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	4 %	0 %	5 %	9⅞— 10⅜	10 — 11	10 7/16	10⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	..	12½— 13⅜	13 — 14		
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid					123 —128	123 —128		
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100				103 —106	104 —107		
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000.	10	4 %	4 %	4 %	8⅜— 9⅜	8⅜— 9⅜	8⅝	
20,000	Do. do. 6 % Pref., 40,001—60,000.	10	6 %	6 %	..	11⅜— 12⅜	11⅜— 12⅜		
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red					111 —114	110 —113	113	111
50,000	Edmundson's Electric Corporation, Ord. Shares	5	6 %	7 %	7 %	6⅛— 6⅝	6⅛— 6⅝	..	..
30,000	Do. do. 6 % Cum. Pref.					6 — 6⅛	6 — 6⅛	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100				107 —110	107 —110		
21,000	Kensington and Knightsbridge Electric, Ord.	5	11 %	12 %	10 %	10 — 11	10 — 11		
90,000	Do. do. do. 4 % Debenture Stock	Stock				101 —104	101 —104		
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	1⅞	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4⅛— 5	4⅛— 5⅛	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock				96 — 99	96 — 99		
100,000	Metropolitan Electric Supply, 1 to 100,000	10	5 %	6 %	6½%	15⅝— 16⅝	15⅝— 16⅝	16	15⅞
220,000£	Do. do. 4½% 1st Mort. Deb. Stock					110 —115	110 —115		
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock				99 —102	99 —102		
10,852	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13⅝— 14⅜	13⅝— 14⅜		
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15 7/16	15½
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	8⅜— 9⅛	8⅜— 9⅛		
150,000£	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5				1⅞— 2⅛	1⅞— 2⅛	..	..
50,000£	Do. do. 4% Deb.	100				80 — 90	80 — 90	..	..
65,000	South London Electricity Supply, Ord.	5				2⅞— 3	2⅞— 3	..	..
110,000	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11⅞— 12⅛	11⅞— 12⅛	12⅛	
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, October 22nd.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£19	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	9d.	9d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	109/-	109/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2½d.	2½d.	..

METALS, &c.		This week.	Last week.	Inc. or Dec.
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b ,, Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	7d.	7d.	..
c ,, Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed)	per lb.	8¾d.	8¾d.	..
c ,, ,, (solid drawn)	per lb.	9½.	9d.	..
g Copper Bars (best selected	per ton	£67	£67	..
g Copper Sheet	per ton	£67	£67	..
g ,, Rod	per ton	£67	£67	..
c ,, (Electrolytic) Bars	per ton	£65	£65	..
c ,, ,, Sheets	per ton	£74	£74	..
c ,, ,, Rod	per ton	£65	£65	..
c ,, ,, H.C. Wire	per lb.	7¼d.	7¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/1 to 3/2½	3/1 to 3/2½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	53/1½	53/5½	4d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£10 17 6 to £11	£11 to £11 2 6	2s. 6d. dec.
g ,, ,, Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases) small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11¼d. to 1/2	11¼d. to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee, Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars		From £15	to £40	..
g Tin, Block	per ton	£120 to £121	£117 10 to £118 10	£2 10 inc.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	1/6½	..
p White Anti-friction Metals— "White Ant" brand	per ton	£36 to £60	£35 to £60	..
j Yarns, 2/16s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11 11	£11 11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23	£23	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons., Ltd. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.P. and Teleg. Works g Messrs. James & Shakespeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys.	Oct. 10	700	+ 70	32,220	+ 3,521	12½	12½
Blackpool and Fleetwood	,, 18	976	+ 6	18,961	— 3,9	7½	7½
Bristol Trys. & Car. Co.	,, 17	4,805	+765	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	,, 10	408	+176	17,980	+ 892	5	5
Dudley—Stourbridge	,, 10	748	+ 76	30,190	+ 3,835	18½	18½
Gateshead	,, 10	872	+249	30,304	+ 5,551	10½	9½
Gravesend—Northfleet	,, 10	211	—	2,9 3	—	3½	—
Greenock—Pt. Glasgow	,, 10	502	+2 4	20,660	+13,418	7½	7½
Hartlepool	,, 10	218	— 25	10,516	+ 1,119	6	4½
Kidderminster	,, 10	120	+,10	5,165	+ 31	4½	4½
Merthyr	,, 10	193	— 80	8,270	— 1,516	3	3
Middleton	,, 10	227	—	8,5 9	—	3½	—
Oldham—Ashton	,, 10	563	+ 65	21,710	+ 3,116	8	8
Poole	,, 10	242	— 3	10,742	— 198	2½	2½
Potteries	,, 10	1,936	+190	60,037	+ 2,715	28½	28½
Rothesay	,, 10	67	+ 20	1,935	+ 470	—	—

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
B.E.T. Co. (*continued*)—							
Southport	Oct. 10	231	+ 66	10,684	+ 3,755	5½	5½
South Staffordshire	,, 10	733	— 78	31,045	— 804	21½	22½
Swansea	,, 10	481	+ 28	19,441	+ 1,265	5½	5½
Taunton	,, 10	56	— 19	2 721	— 231	1½	—
Tynemouth	,, 10	298	+ 88	12,423	+ 1,581	9½	9½
Weston-super-Mare	,, 10	78	—	5,179	—	2½	—
Wolverhampton Dist.	,, 10	902	+178	8, 40	+ 5,872	10½	2½
Central London Railway	,, 18	3,971	+645	102,067	+ 8,906	6	6
City and S. London Ry.	,, 19	3,378	+1,102	45,899	+15,527	6½	4½
Doncaster Corp. Trys.	Sept. 27	—	—	1,516	—	5½	—
Dover Corporation Trys.	Oct. 18	204	— 14	9,412	+ 57	3	3
Dublin United Trys.	,, 17	4,980	+604	79,818	+ 1,256	46	46
East Ham Tramways	,, 18	493	+114	9,029	+ 1,576	5	4½
Glasgow Corp. Trys.	,, 18	12,680	—267	244,117	—11,646	57½	48
Liverpool Overhead Ry.	,, 19	1,520	+ 59	25,360	— 1,146	6½	6½
Newcastle Corp. Trys.	,, 18	5,112	—	—	—	35	—
Sunderland Corp. Trys.	,, 19	1,090	+ 7	—	—	17½	17½

* Compared with the corresponding period of 1901.

TABLE OF ELECTRIC SUPPLY STATIONS IN AUSTRALASIA.

We are indebted to the editor of the *Australasian Ironmonger* for permission to reprint the following useful Table from the columns of that

TABLE OF ELECTRIC SUPPLY STATIONS IN AUSTRALASIA.

We are indebted to the editor of the *Australasian Ironmonger* for permission to reprint the following useful Table from the columns of our contemporary:—

Locality.	Date of commencement of supply.	Supply authority or company.	Engineer or manager.	Secretary or town clerk.	System employed.	Voltage at consumers' terminals.	No. of consumers.	No. of incandescent lamps equiv. 16 c.p.	No. of arc lamps.	Horse-power in motors.	Capacity of plant. kw.	Capacity of plant. Equiv. 16-c.p. lamps.	Boilers.	Engines.	Dynamos.	Price per unit. Lighting.	Price per unit. Power.	Price of gas in neighbourhood.	Remarks.
Sydney ..	..	Corporation	Major Cardew*	T. H. Nesbitt	A.C., 3-phase	240	..	..	..	..	1,500	25,000	5×700-H.P. B. & W. ..	2×1,000 & 1×500 Ferranti	2×600 & 1×300-KW. Dick-Kerr.	..	..	4/-	Contracts just closed.
,, ..	1897	Empire E.L. Co. ..	J. W. Gardam	R. O. Robberds	D.C., ...	200	..	6,000	..	86	400	6,400	4×140-H.P. B. & W. ..	3×90-H.P. & 2×165 Alley and Maclellan.	3 × 60-KW. and 2 × 110-KW. Parker.	6d.	4½d.	4/-	115 Tudor cells; new station just opened.
,, ..	1894	George Adams ..	W. J. Adams	A. E. Blair ..	D.C., 2-wire..	110	..	..	..	..	225	3,600	3 Multitubular ..	2 × 150-H.P. & 1 × 60-H.P. Willans.	2 × 90-KW. and 1 × 45-KW. Siemens.	5d.	4d.	4/-	[illegible]
,, ..	..	Strand E.L. Co. ..	John Kent ..	....	D.C., ...	105	..	..	..	100	600	9,600	6×150-H.P. multitubular	2×150-H.P. Universal .. 2×150-H.P. Willans 4×60-H.P. Willans	2×110-KW. Brush .. 2×110-KW. Siemens. 3×40-KW. Siemens. 1×40-KW. Royce.	4½d.	..	4/-	New station just [illegible] opened.
,, ..	1898	Oxford E. L. Co. ..	H. Langen ..	....	D.C., 2-wire..	220	20	1,200	18	*Nil*	72	1,200	2×75-H.P. multitubular	2×50-H.P. Universal ..	2×36-KW. Mordey ..	5d.	..	4/-	Extensions in view.
Redfern ..	1892	Corporation	J. W. Balfour	R. W. Grierson	A.C., 1,000 v., 70 cycles.	100	115	2,700	19	*Nil*	240	3,800	2×200-H.P. multitubular	2×200-H.P. hor. comp. ..	2×120-Mather & Platt ..	5½d.	..	4/-	Public lighting, 400 25-c.p. series incandescent lamps.
Tamworth ..	1899	Municipal Council ..	W. G. Counsell	W. Hughes ..	D.C., 2-wire..	220	..	200	10	*Nil*	44	700	2×30-H.P. multitubular	2 × 30-H.P. comp. Fowler undertype.	2×22-KW. Crompton ..	..	..	7/6	Public lighting only.
Penrith ..	..	Corporation	....	....	A.C., 1,000 v., 100 cycles	50	..	..	*Nil*	*Nil*	40	640	2×30-H.P. loco.	2×30-H.P.	2×20-KW. B.T.H. ..	..	..	..	£1 per lamp year.
Broken Hill ..	1890	B.H.E.L. & P. station	F. J. Mars ..	....	A.C., 1,100 v., 100 cycles.	110	150	1,800	15	4	220	3,500	3×90-H.P. B. & W. ..	2×100-H.P. Westinghouse.. 1×200 H.P. Belliss	1×70-KW. A.E.G. .. 1×50-KW. Mordey, 1×110-KW. Brown.	1s. & 6d.	6d.	15/-	Fan motors.
Hillgrove ..	..	Hillgr. & Armidale E. Cor., Ltd.	A. L. Cadogan	E. J. Erskine	A.C. light .. D.C. power ..	110 & 1,500	60	52	2	200	530	8,500	Water-power	....	3 D.C., 2 A.C. Crompton ..	..	..	None	Power for mining.
Lambton ..	..	Corporation	....	....	....	....	....	....	....	....	..	..	....	....	....	..	..	..	..
Mossvale ..	..	M.V.E.L. Co.. ..	Chas. Taylor	H. Richardson	A.C.	100	30	400	*Nil*	*Nil*	..	600	....	....	Mordey	..	..	..	..
Newcastle ..	..	Corporation	G. H. Lofts ..	....	A.C., 1,000 v.	....	....	....	....	....	..	..	B. & W.	Westinghouse	Westinghouse	..	..	..	..
Young ..	..	Corporation	G. H. Lofts ..	G. E. Spark..	A.C., 1,000 v. 125 cycles.	56	140	1,060	1	*Nil*	105	1,700	2-75-H.P. multi-locomotive.	2 Fowler undertype comp.	3 T.H., 35-KW.	8d.	..	None	Rate per 16-c.p. lamp, 8d. per week.
Melbourne ..	1894	Corporation	A. J. Arnot ..	....	D.C. & A.C. ..	220 & 100	970	20,000	1,120	92	2,700	43,000	4×250 B. & W. 4×500 ,, ,,	....	5 A.C., 5 D.C., and 26 T.H. arc ltrs.	5d.	3d.	5/-	Converting to D.C. 3-wire.
,, ..	1889	E.L. & T. Co.. ..	F. W. Clement	W. J. Mountain	A.C., 4,000 v. 50 cycles.	200	600	23,000	90	40	1,300	20,000	8×250-H.P. B. & W. ..	2×900-H.P. and 1×400-H.P. Brush univers.	2×500 and 1×200-KW. Brush inductor alternators.	6d.	..	5/-	..
Geelong ..	1901	E.L. & T. Co. of Aust.	F. W. Clement	W. J. Mountain	D.C., 3-wire..	220	..	1,180	20	15	320	5,200	Semi-marine	Belliss compound	Brush .. .. .. 3×25-KW. Brush.	8d.	3d.	6/8	New station being erected.
Bendigo ..	1892	E.S. Co. of Victoria..	B. Sluytermann	G. S. Morison..	A.C. & D.C....	100	112	1,950	81	76	165	2,600	4×70-H.P. B. & W. ..	5×70-H.P. compound	4×12-KW. arc ltrs. 1×40-KW. Ganz A.C.	8d.	8d.	8/4	System in course of reconstruction.
Ballarat ..	1894	E.S. Co. of Victoria..	....	....	D.C., 3-wire ..	..	..	..	..	..	122	..	....	....	....	..	..	..	..
Nhill	1891	J. C. Lockley	....	....	D.C.	..	..	..	..	..	22	..	....	27-H.P.	....	..	..	..	..
Moolort ..	1901	D.L.E.T. Co.	....	....	3-phase	..	..	..	..	..	800	13,000	....	....	....	..	..	None	Power for mining only.
Brisbane ..	1888	B.E.S. Co.	E. C. Barton	W.M.l'Estrange	D.C., 3-wire..	110	160	..	20	20	230	2,900	Lancashire	2×80-H.P. Raworth, 1×80-H.P. Parsons.	2×50-KW. Parker .. 1×50-KW. Parsons.	5d.	3d.	5/-	Output 280,000 units per annum. 100 fan motors.
Charters Towers	1897	C.T.E.S. Co.	F. Warden ..	A. W. Wilson	A.C., 2,000 v.	100 & 200	101	1,713	*Nil*	*Nil*	80	1,300	2×80-H.P. multitubular	2×70-H.P. Browett-Lindley	2×40-KW. Crompton.. ..	1s.	..	12/4	..
Rockhampton	1892	R.G. & C. Co., Ltd.. ..	H. G. Adler ..	A. Lloyd ..	D.C., 2-wire..	110	60	600	25	10	47	800	2 Knapps, root	Paxman, Globe, Westinghouse.	Hookham, Brush, Crompton.	1s. & 9d.	7d.	11/3	Converting to 3-wire.
Adelaide ..	1900	E.L. & T. Co. of Aust.	F. W. Wheadon	H. Ashworth	D.C., 3-wire ..	200	270	5,500	100	192	400	6,800	3×200-H.P. B. & W. ..	2 × 260 and 1 × 360-H.P. Willans.	2×100 and 1×200-KW. Bruce Peebles.	7d.	3d.	6/6	H.T. system in hand for suburbs.
Port Adelaide	1899	,, ,, ,,	,, ,, ,,	,, ,,	,, ,,	200	85	1,600	57	4½	120	1,900	3 Cornish	5 Alley & Maclellan ..	5 Johnson & Phillips ..	8d.	3d.	7/6	..
Hobart ..	1898	H. Gas Co.	A. J. Todd ..	W. J. Campbell	A.C.	110	67	2,000	45	35	152	2,500	....	Willans	100-KW. Siemens 5×100-KW. Siemens.	8d.	3d.	6/8	100-KW. Willans, Siemens set on order.
Launceston ..	1896	Municipal Council ..	Wm. Corin ..	C. W. Rocher	A.C., 2,000 v.	110 & 220	1,525	11,880	118	201	565	9,000	Water-power	5×160-H.P. Thompson vert. turbines.	A.C., 5 Siemens, and arc lighters	6d.-3d 1½d.	2d. & 1d.	7/1	Max demand indicators; changing to 3-phase.
Perth	1898	Perth Gas Co... ..	H. Broadbent	T. Blackney..	D.C., 3-wire ..	220	1,150	20,000	200	100	515	9,300	6×106 & 1×1,000-H.P. B. & W.	4×80 and 3×160-H.P. Willans.	4×50 and 3×105-KW. Castle	8d.-5d.	6d.-3d	7/6	Doubling capacity.
Kalgoorlie ..	1901	K. Pow. & Lt. Co. ..	C. E. Crocker	....	3-phase ..	550	..	..	..	..	1,200	24,000	8×800-H.P. B. & W. ..	3×800-H.P. Stewart ..	3×500-KW. G.E. Co. ..	..	6d.-3d	..	..
Coolgardie ..	..	E.S. Co. of W.A. ..	....	....	D.C.	220	..	..	..	..	220	3,500	....	2×200-H.P. Willans ..	2×120-KW.	..	..	..	..
Claremont ..	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Boulder ..	1899	Corporation	J. Schmidt ..	E. J. Powell..	D.C., 3-wire ..	220	125	3,400	48	1	120	2,500	1 × 120-H.P. B. & W. 1×90-H.P. loco.	1×80-H.P., 2×32-H.P. ..	2×40 & 2×20-KW.	1s. 1d.	1/1	None	Set of accumulators; 3,118 ampere-hours.
Wellington ..	1888	N.Z. Electric Synd..	G. S. Maben..	J. P. Brandon	A.C.	100	2,100	30,000	120	140	950	15,200	4×180-H.P. econ., 2×210-H.P. B. & W. 1×212-H.P. B. & W.	1×600 Browett-Lindley .. 1×550 Brush, 1×300 Brush, 4×150 Paxman.	1×300 Westinghouse .. 1×200 Brush, 1×150 Brush, 4× 75 Gulcher.	5d.-1s.	3d.	5/10	Street lighting by 780 incandescent lamps, 20 c.p. each, and 30 arcs of 15 amperes each.
Rotorua ..	1901	N.Z. Government ..	— Fletcher ..	....	A.C., 4,000 v. 50 cycles.	100	..	400	20	20	100	1,600	Water-power	2×100-H.P. Waverley turbines	2×50-KW. Brush inductor.	6d.	..	None	13-mile transmission, sewage pumping.

* Consulting.

EXPLANATION OF ABBREVIATIONS:—A.C., Alternating Current; D.C., Direct Current; B. & W., Babcock & Wilcox boilers; KW., Kilowatts.

BRITISH ASSOCIATION, BELFAST, 1902.

RECENT PROGRESS IN LARGE GAS ENGINES.

By Herbert A. Humphrey, M.I.Mech.E., A.M.I.C.E., M.I.E.E.

(Abstract of Paper read before Section G, September 11th.)

The development of large gas engines which has taken place during the last few years has but few parallels in the history of engineering enterprise. Gas engines of 1,200 H.P. and 1,500 H.P. are already working, and others of 2,000 H.P. to 4,000 H.P. are being constructed.

Table I.—List of Gas Engines over 200 H.P., Delivered or in Hand.

Style of engines and name of makers.	Engines for driving dynamos.				Engines for other purposes.				Total engines for all purposes.		
	Number of engines.	Horse-power of each.	Total number of engines.	Total horse-power of engines.	Number of engines.	Horse-power of each.	Total number of engines.	Total horse-power of engines.	Total number of engines.	Total horse-power.	Average horse-power per engine.
"Simplex" engine, manufactured by the Société Anonyme John Cockerill, of Seraing, and Licensees.	3 8 3 9 2	1,200 200 250 600 300	25	11,950	2 3 26 3	1,200 800 600 200	34	21,000	59	32,950	558
Körting engine, manufactured by Gebr. Körting, Maschinenbau Aktien Gesellschaft, formerly Gebr. Klein, in Dahlbruch, and Licensees.	7 1 3	1,000 700 500	11	9,200	16 1 1 1 2	2,000 1 000 700 600 500	21	35,300	32	44,500	1,390
Gasmotoren-Fabrik Deutz (Deutz, Köln).	11 12 2 1 7 6 5 1 2 3	200 300 350 400 500 600 1,000 280 250 225	50	20,455	1	200	1	200	51	20,655	405
"Oechelhäuser," manufactured by the Deutsche Kraftgas Gesellschaft and Licensees.	6 3 3 7 3	1,000 600 500 400 300	22	13,000	1 1 4	1,200 700 500	6	3,900	28	16,900	603
Westinghouse Machine and Manufacturing Co., East Pittsburg, U.S.A.	35 4 4 1 1	300 500 650 1,000 1,500	45	17,600	Returns not complete				45	17,600	391
The British Westinghouse Electric and Manufacturing Co., Ltd.	23 1	250 600	24	6,350	1	250	1	250	25	6,600	264
Snow Steam Pump Works, of Buffalo, New York, U.S.A.	—	—	—	—	2 6 1	4,000 1,000 500	9	14,500	9	14,500	1,611
"Premier" engine, manufactured by the "Premier" Gas Engine Co., Sandiacre, Nottingham.	1 4 1 3 9 1	700 600 500 400 250 200	19	7,250	1 1 1 1	1,000 600 250 200	4	2,050	23	9,300	404
Crossley Bros. Ltd., Openshaw, Manchester.	5 1 3 8	500 400 250 200	17	5,270	2 1 1 7	500 400 250 200	11	3,050	28	8,300	296
Struthers, Wells & Co., Warren, Pa.	2	500	2	1,000	—	—	—	—	2	1,000	500
"Letombe" engine, manufactured by Compagnie de Fives Lille, France.	5 4 7	400 250 200	16	4,400	—	—	—	—	16	4,400	275
"Stockport" engine, manufactured by Andrew & Co., Reddish, near Stockport.	3 2	300 250	5	1,400	—	—	—	—	5	1,400	280
"Nürnberg engine, manufactured by Vereinigte Maschinenfabrik Augsburg und Maschinenbau Gesellschaft, Nürnberg.	1 1	700 400	2	1,100	2	1,200	2	2,400	4	3,500	—
Totals	—	—	238	98,955	—	—	89	82,650	327	181,605	555

In the Paris Exhibition of 1900 the 600-H.P. Cockerill gas engine created much surprise, but now the makers have in hand an engine of 2,500 H.P., and are quite prepared to build a 5,000 H.P. gas engine.

In England the first gas engines above 400 H.P. were only started in the year 1900, and they worked with Mond gas. One was a 450-H.P. "Crossley" engine, and the other a 650-H.P. "Premier" engine; both engines had two cylinders, and were direct coupled to large dynamos supplying current for an electrolytic plant at Messrs. Brunner, Mond & Co.'s works at Winnington. Additional gas engine plant is now being added, and all the dynamos work in parallel. At the present time (August, 1902) the two leading English manufacturers have delivered, or have under construction, 51 gas engines, varying in size between 200 and 1,000 H.P. Of these Messrs. Crossley Bros., of Manchester, supply 28 engines, having an aggregate of 8,300 H.P., or an average of 296 H.P. per engine, and the Premier Gas Engine Co., of Sandiacre, Nottingham, supply 23 engines, with a total of 9,300 H.P., giving an average of 404 H.P. per engine. These two makers collectively supply 17,600 H.P., and of this power 12,500 H.P. is for driving dynamos.

This is a striking proof of rapid progress, but we have to look abroad for the great achievements in this direction. Neglecting throughout this paper all engines below 200 H.P., we find that Messrs. Körting Bros. and their licensees have made, or have under construction, 32 gas engines, with a total of 44,500 H.P., averaging 1,390 H.P. per engine. The Société Anonyme John Cockerill, of Seraing, and their licensees, come next, with 59 engines, having an aggregate of 32,950 H.P., so that the average size of the engines built by this firm is 558 H.P. The Gasmotoren-Fabrik Deutz takes the third place with 51 engines, developing collectively 20,655 H.P., and is followed by the Deutsche Kraftgas Gesellschaft and licensees, working under the Oechelhäuser patents, with engines numbering 28, and giving 16,900 H.P. Table I. gives a classified list of these and other large gas engines, and shows the remarkable total of 327 gas engines, capable of supplying 181,605 H.P.

Although America has lagged somewhat behind the Continent in adopting large gas engines, there is evidence that this state of affairs will not long remain. The De la Vergne Refrigerating Machine Co., New York, have taken out a license to manufacture the Körting engine, and have on order 16 2,000-B.H.P. engines (total 32,000 H.P.) of the Körting type; and the Lackawanna Steel Works, Buffalo, U.S., have ordered five 1,000-B.H.P. engines for coupling to dynamos.

It is only a question of time before America will be one of the largest producers of gas engines, and one enterprising American firm, the Snow Steam-Pump Works, of Buffalo, New York, has already put to successful work six 1,000-H.P. gas engines, and has

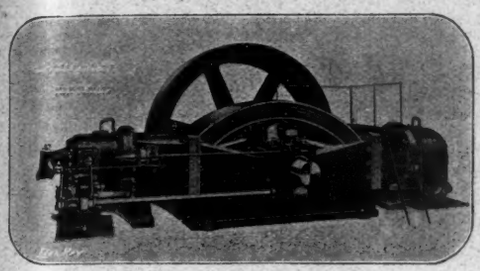


FIG. 1.

now nearly completed the construction of two enormous gas engine gas-compressors of 4,000 H.P., the first to be running by next November, and the second by January, 1903. The Westinghouse Machine and Manufacturing Co., of East Pittsburg, have made gas engines of 1,500 H.P., and are prepared to build sizes up to 3,000 H.P.

Fig. 1 is a view of the standard 500-H.P. Crossley gas engine. It is a two-cylinder *vis-à-vis* engine, with both connecting rods coupled to the same crank. The Otto cycle is employed, and

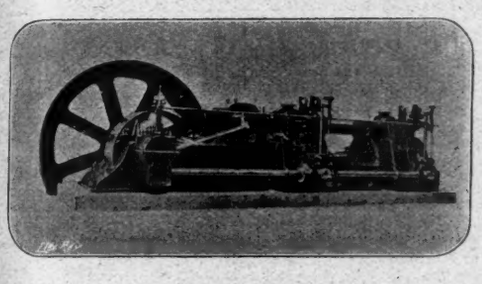


FIG. 2.

the explosions follow at unequal intervals, two explosions taking place in one revolution and none in the next. The diameter of the cylinders is 28 in., length of stroke 36 in., and speed 150 revolu-

TABLE II.—*Cockerill "Simplex" Gas Engines Working with Blast Furnace Gas.*

Reference Number.	Horse-power.	System.	Revolutions per minute.	Diameter of cylinder.	Length of stroke.	Regularity.	
						Absolute.	Cyclical.
I. *a*	100	Single-cylinder	150	600 mm. (23·62 in.)	803 mm. (31·5 in.)	35	60
b	225	Tandem	150	"	"	41	80
c	450	Double-tandem	150	"	"	52	200
II. *a*	200	Single-cylinder	150	750 mm. (29·5 in.)	900 mm. (35·5 in.)	42	78
b	425	Tandem	150	"	"	50	96
c	850	Double-tandem	150	"	"	65	260
III. *a*	300	Single-cylinder	120	900 mm. (35·5 in.)	1 m. (39·375 in.)	63	110
b	650	Tandem	120	"	"	77	150
c	1,300	Double-tandem	120	"	"	140	400
IV. *a*	475	Single-cylinder	100	1·160 m. (43·3 in.)	1·200 m. (47·24 in.)	63	105
b	1,000	Tandem	100	"	"	74	140
c	2,000	Double-tandem	100	"	"	95	380
V. *a*	600	Single-cylinder	90	1 398 m. (51·18 in.)	1·400 m. (55·11 in.)	19	30
b	1,250	Tandem	90	"	"	23	43
c	2,500	Double-tandem	90	"	"	29	120
	200	Single-cylinder, bayonet constructed	105	850 mm. (33·5 in.)	1 m. (39·375 in.)	33	55

NOTE.—The cyclic speed variation is equal to the maximum angular velocity minus the minimum angular velocity divided by the mean angular velocity. The reciprocal of this is the *regularity* given in the last column. When the governor cuts out one admission of gas the regularity is diminished, and is then called the "absolute regularity," as shown in the last column but one.

tions. Of the seven engines of this size, four are working with Mond gas, two with Dowson gas, and one with blast furnace gas. A smaller engine (150 H.P.) of the same type ran for 198 days and nights at nearly full load without a single stop, and holds the world's record in this respect.

Fig. 2 is a view of the 650-H.P. Premier gas engine of the tandem positive scavenger type. The motor cylinders are placed in tandem, and the front cylinder has an enlargement, in which an additional piston compresses the air required both for scavenging and combustion. The large air piston acts as a guide for taking the oblique thrust of the connecting rod, and also assists in bringing the re-

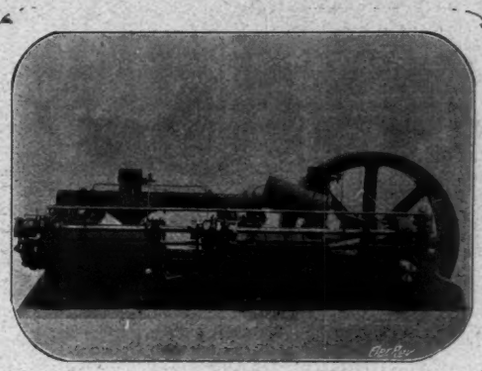


FIG. 3.

ciprocating parts to rest by cushioning the air on the return stroke, thus facilitating smooth running and helping to keep the connecting rod always in compression. The motor cylinders are 28½ in. in diameter, the scavenger cylinder 43½ in. in diameter, and the common stroke 30 in. The engine runs well at 125 revolutions per minute.

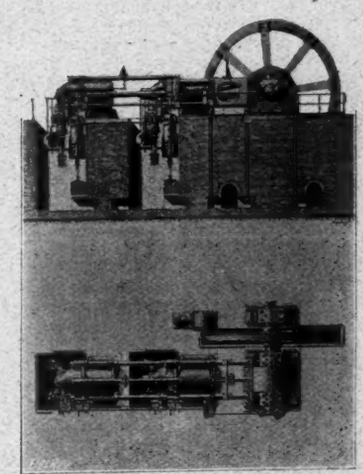


FIG. 4.

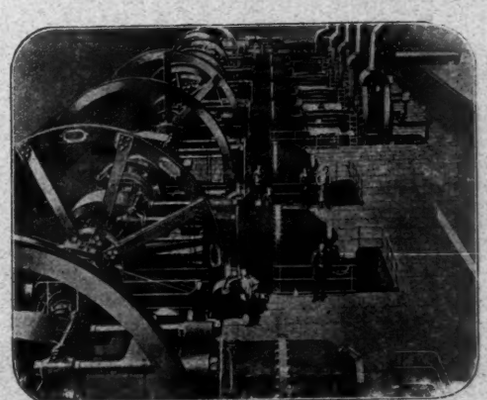


FIG. 5.

Fig. 3 shows the new type 500-H.P. Premier engine, in which the scavenging is performed by a separate cylinder placed at an incline and driven from an attachment to the main connecting rod. The

motor cylinders are 27 in. diameter, the stroke 27 in., and the speed 150 revolutions per minute. In this engine the side rods shown in the previous slide are dispensed with, and the two pistons are joined by a tail rod passing through a gland in the front cylinder. All the valves are positively driven from the elevated side shaft shown, and are both opened and closed mechanically. The levers for this purpose carry conical rollers, engaging in grooved cams, and when two engines are placed side by side to give a 100-H.P. combination, the same side shaft and cams serve for both, thus making a very simple and compact arrangement. The author carried out a very successful 24-hour trial of this 500-H.P. engine a few months ago, the engine using Mond gas.

We now come to engines of the "Simplex" type, the original designs for which were prepared by M. Delamare Debouteville, who did, perhaps, more than any other man to hasten the advent of large gas engines, and whose early death deprived the engineering profession of one of its most skilful and courageous workers. The Simplex engine was the first to give 300-H.P. in a single cylinder; but after passing into the hands of the Société Anonyme John Cockerill the development of this type has been marked by rapid progress, and as much as 1,250 H.P. can now be obtained from one cylinder.

Fig. 4 shows the elevation and plan of a Cockerill engine of the tandem type, of 600 H.P., arranged for dynamo driving direct, at 150 revolutions per minute. The Cockerill Co. are now building an engine of exactly this type for 2,500 H.P., or 1,250 H.P. per cylinder. By duplicating the arrangement, we arrive at a four-cylinder double tandem engine of 5,000 H.P.

Fig. 5 shows nine Cockerill gas engines erected for the Société des Hauts-Fourneaux de Differdange, each of 600 H.P., three being direct coupled to dynamos and six to blowing cylinders for producing the blast required by the furnaces. These engines work with blast-furnace gas, purified by passing it through centrifugal fans with water injection.

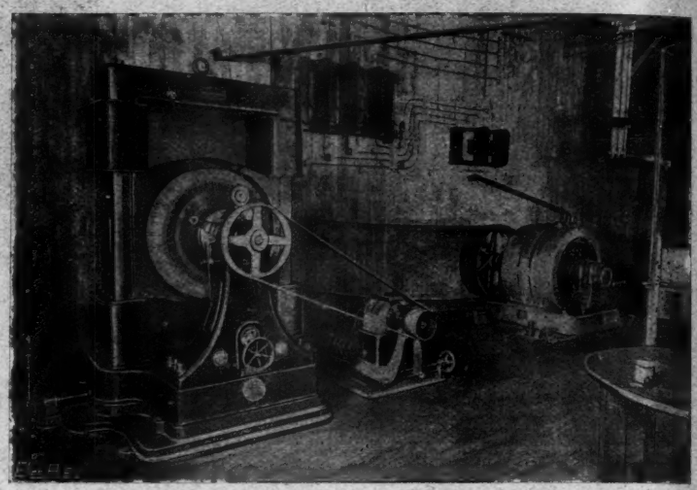
The aggregate power of the engines shown in this slide is 5,400 H.P., and the Cockerill Co. are supplying an even larger horse-power to Messrs. Wendell & Co., where nine engines have a total of 6,700 H.P., and include three dynamo engines of 1,200 H.P. each.

(To be continued.)

THE MANUFACTURE OF NITRIC ACID AT NIAGARA FALLS.

By ORRIN E. DUNLAP.

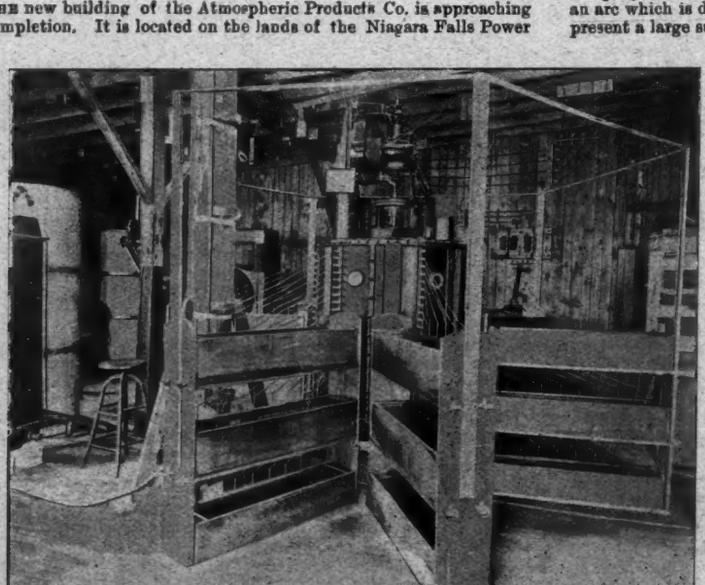
The new building of the Atmospheric Products Co. is approaching completion. It is located on the lands of the Niagara Falls Power Co., on Buffalo Avenue, in front of the upper works of the Pittsburg Reduction Co. The building is of brick, substantially built. When finished it will be used as a machine shop, in which the apparatus for the company's proposed new factory for the manufacture of nitric acid will be made. It is the company's intention to begin operations in their factory with 2,000 H.P. The space required for their apparatus will be large; it is interesting to observe that to supply all of the nitric acid used in the United States alone would require the use of 150,000 H.P., in a factory that would cover many acres of floor space. The company's process is a success, and to meet even this enormous requirement would simply mean a vast extension of its facilities. Located as the works are at Niagara, it is evident that the want of power will never retard their development.



45-KW. 15,000-VOLT DYNAMO.

The Atmospheric Products Co. was incorporated in May, 1902, with a capital of $1,000,000. The process was evolved by Charles S. Bradley, who is president of the company, and was worked out in an experimental plant at Niagara Falls by D. Ross Lovejoy, the company's electrician. The papers of incorporation mention Charles S. Bradley, William E. Knight, William F. Crawford, Harry E. Knight, David J. Newland, C. von Gruever and William P. Hammond, all of New York, as directors. The patent claims of the company are for "exposure of a mixture of nitrogen and oxygen to the action of an electric arc, and renewing the mixture so as to prevent dissociation." The patent is for a method of producing nitrogen compounds from atmospheric nitrogen.

In the experimental station a 45-KW. generator, which ordinarily delivers 0·75 ampere direct current at 8,000 volts, but of a capacity to give several amperes at 15,000 volts, has been in use. The company has found it necessary, in order to secure efficiency, to use an arc which is divided into small, thin, flat sub-divisions, so as to present a large surface for a small amount of power. In fact, the thinner the arc, the greater is said to be its efficiency up to the point where it is broken. There are 138 of these arc contacts, and each is made and broken 50 times per second, each arc receiving about 0·005 ampere. Despite the number of the arcs, they are all sprung successfully, 6,900 in the apparatus in use, each arc lasting about one 20,000th of a second. When the arcs form there is a sudden increase in the current, and short-circuiting is prevented by inductance coils in series with the arcs. These retard the current for about one 40,000th of a second, and during the remainder of the period, or another one 40,000th of a second, the arc is drawn out and about to break, their effect is to prolong the arc. When 8,000 volts are used, with an average of 1-200th of an ampere to an arc, the arcs are drawn out 4 to 6 inches.



VIEW OF EXPERIMENTAL NITRIC ACID PLANT.

During the time the company has been experimenting at Niagara Falls, its apparatus has been located in the Ampere Electro-chemical Co.'s plant in the rear of the United Barium Co.'s factory. The apparatus is well shown in the illustrations. It is of iron, standing 5 ft. high, and is 14 ft. in diameter. Attached to the sides there are six rows of inlet wires, 23 to a row. A vertical shaft runs through the centre, and contains a series of 23 radial arms. Each plane has six radial arms. The radial arms are tipped with platinum wires that extend to within ⅛ in. of the similar wires on the opposite poles. When the two points get close a spark leaps about ½ in. to meet the approaching point, and as the point retreats the arc is drawn out. In series with each arc is a resistance coil 12 in. long and 5 in. in diameter, immersed in oil, and containing several thousand turns of wire. To run the central

shaft at 500 r.p.m. requires, it is said, a trifle over a single horse-power, while 5 H.P. is required to give it a velocity of 1,000 r.p.m. The theoretical output is 1 lb. of nitric acid per 7 H.P.-hours of energy used.

While air can be used in the apparatus, after being dried, it has been ascertained that a mixture of equal parts of oxygen and nitrogen gives better results. Air, it will be recalled, contains one part of oxygen to about four of nitrogen, while gases formed contain one part oxygen to one and a half or two of nitrogen. A renewal of the gases is made to the extent of 3 to 4 cub. ft. a minute. The gases pass into an iron reservoir that has a height of 10 ft. and a diameter of 2 ft., where they still further combine, and then pass into a scrubbing tower. This tower is of earthenware pipe, 9 in. in diameter, and 25 ft. high. It is filled with coke, and if nitric acid is the product desired, water runs over it, or, if alkaline nitrate is desired, a solution of caustic alkali is used. Calcium nitrate is made by using a scrubber supplied with milk of lime.

The possibilities before a successful industry of this kind are almost beyond conception. The world's supply of fixed nitrogen is largely in the form of Chili saltpetre, an article the supply of which is being exhausted so rapidly that it is said only 30 years' supply is in sight. The world's supply of wheat this year is estimated to be between 2,861,000,000 and 2,905,000,000 bushels. Before the British Association for the Advancement of Science in 1898 Sir William Crookes pointed out that, by 1931, the amount required by the bread-eating people would be 3,600,000,000 bushels. While also stating that Nature would not long honour the drafts upon her supply of fixed nitrogen, he pointed out that by 1931 it would require something like 1,200,000 tons to bring the wheat crop of 1930 up to the amount that humanity will require. It is in supplying this that this wonderful discovery which is about to be put in commercial operation at Niagara will be of vast benefit to the world. In addition to the United States, India, Australasia, France, Germany and Austria-Hungary are wheat-producing countries, and are, therefore, interested in this new development that is to be made of benefit to mankind through the power of Niagara.

WASHINGTON, BALTIMORE & ANNAPOLIS SINGLE-PHASE RAILWAY.*

By R. G. LAMME.

(*Concluded from page 656.*)

The motors on the car are all of the straight series type. The armature and fields being connected in series, the entire current of the field passes through the armature as in ordinary series direct-current motors. The motor has eight poles, and the speed is approximately 700 revolutions at 220 volts. The general construction is similar to that of a direct-current motor, but the field core is laminated throughout, this being necessary on account of the alternating magnetic field. There are eight field coils wound with copper strip, and all connected permanently in parallel. The parallel arrangement of field coils assists in equalising the field strength in the different poles, due to the balancing action of alternating circuits in parallel. This arrangement is not really necessary, but it possesses some advantages and therefore has been used. With equal magnetic strength in the poles, the magnetic pull is equalised even with the armature out of centre.

The armature is similar in general construction to that of a direct-current motor. The fundamental difficulty in the operation of a commutating type of motor on single-phase alternating current lies in the sparking at the brushes. The working current passing through the motor should be practically no more difficult to commutate than an equal direct current, and it is not this current which gives trouble. The real source of trouble is found in a local or secondary current set up in any coil, the two ends of which are momentarily short-circuited by a brush. This coil encloses the alternating magnetic field, and thus becomes a secondary circuit, of which the field coil forms the primary. In the motors of the Washington, Baltimore and Annapolis Railway, this commutation difficulty has been overcome, by so constructing the motor that the secondary or short-circuit current in the armature coil is small, and the commutating conditions so nearly perfect, that the combined working and secondary currents can be commutated without sparking. This condition being obtained, the motor operates like a direct-current machine, and will give no more trouble at the commutator than ordinary direct-current railway motors. Experience covering a considerable period in the operation of motors of 100 H.P. capacity indicates that no trouble need be feared at the commutator.

An extended series of tests was made with these motors at the Westinghouse shops at Pittsburg, both in the testing room and under a car. Fig. 2 shows curves of the speed, torque, efficiency, and power factor plotted from data derived from brake tests.

It should be noted that the efficiency is good, being very nearly equal to that of high-class direct-current motors. The power factor, as shown in these curves, is highest at light loads and decreases with the load. This is due to the fact that the power developed increases approximately in proportion to the current, while the wattless component of the input increases practically as the square of the current. The curve indicates that the average power factor will be very good. The calculations for the Washington, Baltimore and Annapolis Railway show that the average power factor of the motors will be approximately 86 per cent.

The average efficiency of these equipments will be much higher during starting and accelerating than that of corresponding direct-current equipments, as rheostatic losses are avoided. When running at normal full speed, however, the efficiency will be slightly less than with direct current. This is due to the fact that the alternating-current motor efficiency is slightly lower than the direct-current, and in addition there are small losses in the transformer and the regulator. The alternating-current equipments are somewhat heavier than the direct-current, thus requiring some extra power, both in accelerating and at full speed. Therefore, for infrequent stops the direct-current car equipment is more efficient than the alternating-current, but for frequent stops the alternating-current shows the better efficiency. Tests on the East Pittsburg track verified this conclusion. But the better efficiency of the direct-current equipment with infrequent stops is offset with the alternating-current by decreased loss in the trolley wire, by reason

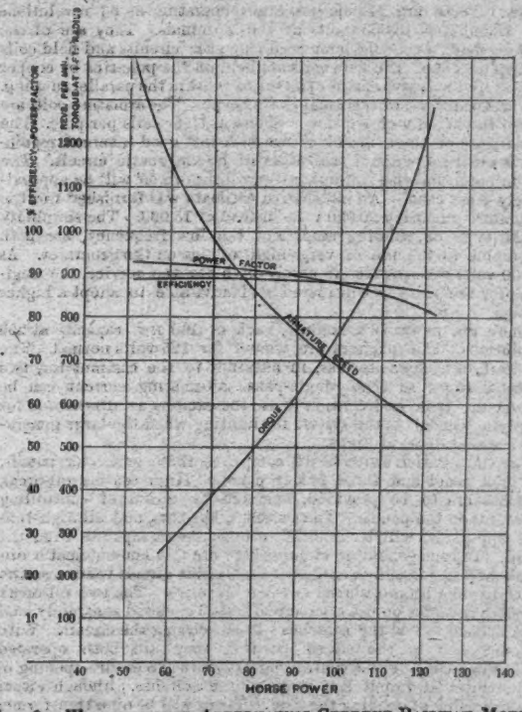


Fig. 2.—Westinghouse Alternating Current Railway Motor. No. 91—Single-phase—220 Volts.

of the higher voltage used, and by the elimination of the rotary converter losses. The resultant efficiency of the system will therefore be equal to, or better than, that of the direct current.

In the Washington, Baltimore and Annapolis Railway contract the guarantee given by the Westinghouse Electric and Manufacturing Co. states that the efficiency of the system shall be equal to that of the direct-current system with rotary converter sub-stations.

There is one loss in the alternating-current system which is relatively much higher than in the direct-current. This is the loss in the rail return. Tests have shown that at 2,000 alternations it is three to four times as great as with an equal direct current. This would be a serious matter in cases where the direct-current rail loss is high. But the higher alternating-current trolley voltage reduces the current so much that the alternating-current rail loss is practically the same as with direct current at usual voltages. In many city railways the direct-current rail loss is made very low, not to lessen waste of power, but in order to reduce electrolysis. In such cases the alternating-current rail loss could be higher than direct current, thus decreasing the cost of return conductors. More numerous transformer sub-stations, with copper feeders connected to the rails at short intervals, will enable the rail loss to be reduced to any extent desired.

As a frequency of 2,000 alternations per minute is used, the lighting of the cars and the sub-stations was at first considered to be a serious difficulty, due to the very disagreeable winking of ordinary incandescent lamps at this frequency. Two methods of overcoming the winking were tried, both of which were successful. One method was by the use of split phase. A two-phase induction motor was run on a single-phase 2,000 alternating circuit, and current was taken from the unconnected primary circuit of the motor. This current

* Abstract of a paper read before the American Institute of Electrical Engineers, September 26th, 1902.

was, of course, at approximately 90° from the current of the supply circuit. A two-phase circuit was thus obtained on the car. Currents from the two phases were put through ordinary incandescent lamps placed close together. The resulting illumination a few feet distant from the lamps showed about the same winking as is noticed with 3,000 alternations. With two filaments in one lamp the winking disappeared entirely. A three-phase arrangement would work in the same way.

A much simpler method was tried which worked equally well. This consisted in the use of very low-voltage lamps. Low voltage at the lamp terminals allows the use of a thick filament with considerable heat inertia. Tests were made on lamps of this type at a frequency of 2,000 alternations, and the light appeared to be as steady as that from the ordinary high-frequency incandescent lamp. The low voltage is not objectionable in this case, as a number of lamps can be run in series, as in ordinary street railway practice, and any voltage desired can readily be obtained, as alternating current is used on the car.

There will be an air compressor, driven by a series alternating-current motor, on each car, for supplying air to the brakes and for operating the driving mechanism of the controller. The details of this mechanism are not sufficiently near to completion to permit a description of it. The method used will be one which readily allows operation on the multiple-unit system.

The generating station contains some interesting electrical features, but there is no great departure from the usual alternating-current practice. There will be three 1,500-kw. single-phase alternators. These are 24-pole machines operating at 83 revolutions and wound for 15,000 volts at the terminals. They are of the rotating field type, with laminated magnetic circuits and field coils of strip on edge. The field coils are held on the pole-tips by copper supports, which serve also as dampers to assist in the parallel running. The armatures are of the usual slotted type. The armature coils are placed in partially closed slots. There are four coils per pole. The proportions of these machines are such that good inherent regulation is obtained without saturation of the magnetic circuit. The rise in potential with non-inductive load thrown off will be approximately 4 per cent. An alternative estimate was furnished for the generators proposing 20,000 volts instead of 15,000. The simplicity of the type of winding used, and the low frequency, are both favourable to the use of very high voltage on the generator. As 15,000 volts was considered amply high for the service, the engineers for the railway considered it inadvisable to adopt a higher voltage.

There are to be two exciters, each of 100 kw. capacity at 250 revolutions. The exciters are wound for 125 volts normal. The armature of each exciter has, in addition to the commutator, two collector rings, so that single-phase alternating current can be delivered. It is the intention to use the exciters as alternators for supplying current to the system for lighting when the large generators are shut down at night.

The main station switchboard comprises three generator panels, one load panel and three feeder panels. High tension oil-break switches are to be provided, operated by means of controlling apparatus on the panels. The switches, bus-bars, and all high tension apparatus, will be in brick compartments separate from the board. In each generator circuit there are two non-automatic oil-break switches in series, and on each feeder circuit there are two overload time limit oil-break switches in series. The two oil-break switches in series on the same circuit can be closed separately and then opened to test the switches without closing the circuit. With the switches in the closed position they are both operated at the same time by the controlling apparatus to ensure opening of the circuit, and to put less strain on the switches, although either one is capable of opening the load. There will be nine transformer substations distributed along the railway line. Each station will contain two 250-kw. oil-cooled lowering transformers, supplying approximately 1,000 volts to the trolley system. Two transformers are used in each station, so that in case of accident to one transformer the station will not be entirely crippled.

It is the intention of the railway company to operate a direct-current road already equipped with the direct-current system. The present direct-current car equipments are to be retained, but the current will be supplied from a rotary converter sub-station fed from the main system of the Washington, Baltimore and Annapolis Railway. As this system is single-phase, it is necessary that single-phase rotaries be used in the sub-stations. There are to be two 200-kw. 550-volt rotary converters. These are four-pole 500-revolution machines, very similar to the Westinghouse polyphase rotary converters. The armature resembles that of a polyphase rotary, except in the number of collector rings, and in certain details of the proportions made necessary by reason of the use of single-phase. The commutating proportions are so good that any reactions due to the use of single-phase will result in no injurious effect. The field construction is similar to that of a polyphase rotary. The laminated field poles are provided with dampers of the "grid" or "cage" type, a form used at present in the Westinghouse polyphase rotary converters. These dampers serve to prevent hunting, as in the polyphase machines, and also to damp out pulsations due to single-phase currents in the armature. The damper acts to a certain extent as a second phase. Each rotary converter is started and brought to synchronous speed by a small series alternating-current motor on the end of the shaft. The voltage at the motor terminals can be adjusted either by loops from the lowering transformer or by resistance in series with the motor, so that true synchronous speed can be given to the rotary converter before throwing it on the alternating-current line.

From the preceding description of this system and the apparatus used on it, some conclusions may be drawn as to the various fields where it can be applied to advantage. It is evident that a good field for it will be on interurban long distance lines such as the Washington, Baltimore and Annapolis Railway. On such railways, high trolley voltage and the absence of converter sub-stations are very important factors.

For heavy railroading also, this system possesses many ideal features. It allows efficient operation of large equipments at practically any speed and any torque, and avoids the controller troubles which are ever present with large direct-current equipments. It also permits the use of high trolley voltage, thus reducing the current to be collected. In this class of service the advantages of this alternating-current system are so great that it is possible that heavy railroading will prove to be a special field for it.

For general city work this system may not find a field for some time to come. It is probable that at first it will be applied to new railways or in changing over steam roads rather than in replacing existing city equipments.

When the alternating-current system applied to interurban and steam railways finally becomes of predominant importance, it is probable that the existing direct-current railways will gradually be changed to alternating current as a matter of convenience in tying the various lines together.

The alternating-current equipments cannot conveniently be operated on direct-current lines. It does not follow, however, that the motor will not operate on direct current. On the contrary, the motor is a first-class direct-current machine, and if supplied with suitable control apparatus and proper voltage it will operate very well on the direct-current lines.

In some cities very strict laws are in force in regard to the voltage variations in various parts of the track system to avoid troubles from electrolysis. The alternating current system will, of course, remedy this.

In the Washington, Baltimore and Annapolis Railway, the generators are wound for single-phase. In the case of large power stations with many feeders the generators may be wound for three-phase, with single-phase circuits carried out to the transformer sub-station; or three-phase transmission may be used, with the transformers connected in such a manner as will give a fairly well-balanced three-phase load.

There are many arrangements and combinations of apparatus made possible by the use of alternating current in the car equipment, which have not been mentioned, as it is impracticable to give a full description of all that can be done. But enough has been presented to outline the apparatus and to indicate the possibilities of this new system, which is soon to see the test of commercial service.

SIMPLE OIL TESTER.

A simple apparatus is manufactured by the E.A.G. vorm W. Lahmeyer & Co., Frankfurt, and supplied by the Lahmeyer Electrical Co., 109—111, New Oxford Street, W.C., for accurately testing the frictional coefficient of different grades of oil at varying temperatures.

It consists of a short length of shaft running in a ring-lubricated bearing, and carrying a heavy fly-wheel at each end, which produces the ordinary pressure on the bearing.

This shaft is provided with a pin coupling, so that the motive power (either electrical, mechanical, or hand) can be uncoupled at any moment while running. The apparatus is supplied in four types, viz.—(*a*) Electrically driven; (*b*) mechanically driven; (*c*) for hand power; and (*d*) for laboratory purposes. The last is provided with fly-wheels for different bearing pressures, and an exact arrangement for measuring speed.

In the case of the electrically-driven oil tester, a motor is provided with an output of about ⅓ h.p., running at a speed of 1,800 r.p.m.; this is mounted on a combined base plate with the oil tester, and drives the latter by means of a pin coupling.

The method of testing is as follows:—

The bearing is supplied with the oil to be tested, the motor is started, and the fly-wheel shaft is run at full speed for a certain time. The motor is then uncoupled, and the time noted which the apparatus takes in coming to rest. The better the quality of the oil, the longer the shaft will run before coming to rest. Before testing the next sample of oil, the bearing is quickly cleaned by passing benzine through it, and blowing out the bearing with an air current. This obviates any necessity of taking the apparatus to pieces, and has been proved perfectly efficient by detailed tests which have been made.

The frictional coefficient of various classes of oil can also be tested under normal conditions, as the apparatus is fitted with either electrical resistance coils with a wide range of regulation for warming the bearing to the desired temperature, or, in the case of the mechanically-driven set, with tubes in the oil reservoir, through which hot water may be passed. These tubes can also be utilised for cooling, by passing cold water through them.

The mechanically-driven apparatus is of similar construction to the former, with coupling to disengage when required. In the case of the oil tester for hand power, two small reduction gear spindles are supplied, so as to obtain a speed of 1,500—1,700 r.p.m. at the fly-wheel spindle.

With regard to the purchase of oil, it is desirable, before obtaining it in quantities, that 1-pint samples should be sent in with the quotation, as the oil tester requires about half a pint. The sample

should first be tested to see that it is free from acid; this is done in the most simple manner by dipping in the oil a polished copper plate, and after a time noticing whether there is any difference between the part of the copper plate which was immersed in the oil and the part left out. After this, the oil should be tested in comparison with other classes of oil in the tester, as before described.

Whether the oil is likely to solidify or not can be tested by putting the oil between two polished iron plates and laying them together. Should the oil be at all liable to solidify, it will be found after a short time that it is a difficult matter to move the iron plates against one another. Should, however, it be found that the oil easily withstands this test, especially after being in stock a few weeks, the required quantity can be ordered with safety.

The apparatus can also be used for ensuring that further supplies of oil are up to the standard, so that with this oil tester there is always a simple and effective control of the oil being supplied from time to time.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,887. "Improvements in brackets for carrying electric fans." J. Annal. October 6th.

21,706. "Improvements in and relating to telegraphic recording apparatus." J. T. Armstrong and A. Orling. October 6th.

21,732. "Improvements in telephone signalling systems." A. Ekstrom. October 6th. (Complete.)

21,733. "Improvements in and relating to electric fans." J. C. Fell. (W. Elswood Coleman, United States.) October 6th. (Complete.)

21,734. "Improvements in telephone apparatus." G. Houbigant. October 6th.

21,742. "Improvements in electric arc lamps." A. M. Arter. October 6th.

21,765. "A new or improved electric rheostat." R. A. Lehfeldt. October 7th.

21,771. "Improvements relating to electric rail or track bonds." W. R. Bowker. October 7th.

21,842. "Improvements in insulators." J. G. Lorrain. (E. H. Tyler, India.) October 7th.

21,855. "An improved electrical indicator." D. Wells. October 8th. (Complete.)

21,882. "Improvements in or relating to electric indicating apparatus." A. Duvenbeck. October 8th.

21,885. "Improvements in electric lampholders." J. A. Hawksworth and D. R. Broadbent. October 8th.

21,886. "Improvements in systems of electrical distribution." B. G. Lamme. (Date applied for under Patents Act, 1901, October 14th, 1901, being date of application in United States.) October 8th. (Complete.)

21,901. "Improvements in electric accumulators." P. Schmitt and C. Faure. October 8th.

21,913. "Improvements in alternating current motors." L. Schuler and Ferranti, Ltd. October 8th.

21,914. "Improvements in and relating to the regulation of dynamo-electric machines." H. H. Lake. (General Electric Co., United States. October 8th. (Complete.)

21,935. "Improvements in plug boxes and in plugs therefor for electric lighting." G. Smith. October 9th.

21,938. "An improved automatic suspension and electrical contact appliance for apparatus requiring to be raised and lowered." F. J. Turquand. October 9th.

21,969. "Electric meter." E. S. Halsey. (Date applied for under Patents Act, 1901, March 13th, 1902, being date of application in United States.) October 9th. (Complete.)

22,023. "Improvements in insulators used for electrically dividing into sections trolley wires as used on electric railways." H. Brecknell, E. M. Munro and H. I. Rogers. October 10th.

22,024. "Improvements in life guards or fenders for electric cars and other road vehicles." E. M. Munro, H. Brecknell and H. I. Rogers. October 10th.

22,050. "Improvements in and connected with electric switches." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) October 10th.

22,106. "An improvement in safety fuses for electric leads." Siemens Bros. and Co., Ltd. (Siemens & Halske, Actien Gesellschaft, Germany.) October 10th. (Complete.)

22,107. "Improvements in sockets for safety fuses for electric leads, partly applicable also to sockets for glow lamps." Siemens Bros. & Co., Ltd. (Siemens and Halske, Actien Gesellschaft, Germany.) October 10th. (Complete.)

22,108. "Improvements in electrical safety fuses." Siemens Bros. & Co., Ltd. (Siemens & Halske, Actien Gesellschaft, Germany.) October 10th. (Complete.)

22,135. "Improvements in and relating to the electrolytic decomposition of alkaline chlorides." J. D. Gilmour. October 11th.

22,147. "Electrical fog signal patent for railways." T. Wilson. October 11th.

22,152. "Improvements in telephone call boxes." R. Hall. October 11th.

22,171. "An arrangement for automatically changing the direction of an electric motor by temperature variations." T. P. Hansen. October 11th. (Complete.)

22,188. "Improvements in overhead trolley tracks for electric tramways and the like." W. J. Sumner. (Date applied for under Patents Act, 1901, July 16th, 1902, being date of application in United States.) October 11th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1899.

14,101. "Improvements in coils or helices for electrical purposes." W. G. Hoys. (J. Scott, R. Varley and J. C. Anderson, all of U.S.A.) Dated August 7th, 1900. Relates to coils or helices for electro-magnets, induction coils, relays, and other electrical apparatus, wherein the helix proper is of bare copper wire wound in layers side by side with a silk or other insulating cord, adjacent layers being separated from each other by insulating sheets of paper or other material. 5 claims.

14,104. "Improvements in electrodes for use in electro-chemical purposes." O. Lauskaar. (A. Vogelsang.) Dated August 7th, 1900. Electrodes are formed of platinum or other metallic foil which is unacted upon, and which in addition to acting as the electrodes, both anode and cathode, acts as the conductor of the current. In the example shown, which is designed for decomposing a salt solution to obtain a bleaching liquor, the vat is formed of insulating material, and is provided with an inlet and outlet for the electrolyte, and with platinum-foil electrodes. The latter are formed by cementing the foil round non-conducting rods or bars, so that the parts of the foil act as electrodes, and parts as conductors of the current. 2 claims.

14,121. "Improvements in methods of and means for electrically-producing light." C. C. Marks. (General Electric Company, U.S.A.). Dated August 7th, 1900. Relates to arc lamps; vacuum tubes. An arc is produced between mercury or other substance vaporisable at a low temperature, and an iron or other solid electrode, or between two mercury electrodes, and is too long for purposes of abridgment. 88 claims.

14,212. "Improvements in or relating to electric furnaces." A. J. Boult. (Union Carbide Company, U.S.A.). Dated August 8th, 1900. The electrodes or movable parts of furnaces are operated by motors controlled automatically by the furnace currents, to keep these currents approximately constant; the electro-magnetic switches used for this purpose may be at a distance from the furnaces. Hand switches are also provided near the furnaces. 7 claims.

14,275. "Improvements in and relating to electro-chemical or copying telegraphs. G. C. Dymond. (Kopier-Telegraph Gesellschaft mit Beschrankter Haftung, Germany.) Dated August 9th, 1900. Relates to an electro-chemical or copying telegraph in which a message recorded in insulating ink on a conducting sheet is reproduced by chemical means on a sheet containing an electrolytic material. 8 claims.

14,281. "Improvements in telegraphy by means of alternating currents and imperfect contacts." G. Ferrie. Dated August 9th, 1900. Relates to a system of telegraphy in which are signals transmitted by means of alternating currents, such as those produced by an induction coil and an imperfect contact or coherer is employed at the receiving station for controlling the local circuit. 5 claims.

14,288. "Improvements in electro-magnetic apparatus for jacquards." J. Szczepanik and Kleinberg. Dated August 9th, 1900. In electrical jacquards, electro-magnets are located in a conducting box, and are in contact with spring buttons which are mounted in removable board, and are electrically connected by wires with similar buttons mounted in another removable board. The buttons bear on the contact levers, the other ends of which rest upon the movable templet, formed with conducting and non-conducting portions. The circuit is completed by a lever and wires. 2 claims.

14,289. "Improvements in electric switches." A. W. B. Pearson. Dated August 9th, 1900. In a tumbler switch, the contact lever is made short, so that, in the off position, it may rise approximately vertically, the operating lever being curved to allow this. In order to give a quick break, a pawl engages with the lever, and is not disengaged until the handle has nearly completed its movement. The roller is preferably made of insulating material. 5 claims.

14,291. "An improved process for the disintegration of minerals or ores." E. L. Graham. Dated August 9th, 1900. Relates to a process for disintegrating ores and minerals, and consists in immersing them in a solution of sulphuric or hydrofluoric acid, or both, and subjecting to the action of electricity. The process may be carried out in a series of vats, in which the electrodes are placed. Other acids may be added to the solution, and also salts of barium and ammonium. The disintegrated oil is ready for concentration. 3 claims.

14,367. "Improvements in collectors for use in overhead systems of electric traction and the like." K. de Kando. Dated August 10th, 1900. Roller contacts for use in systems of electric traction are constructed so that the ball bearings shall be insulated. In the construction shown the rolling contact having a tapering end, is mounted on ball bearings, which are supported on an insulating rod. Electrical contact is made by carbon brushes pressed against the end of the roller contact by a spring. The roller may be provided with single or double contacts. 1 claim.

14,368. "Improvements in liquid rheostats operated by means of compressed air." C. de Kando. Dated August 10th, 1900. In the liquid resistance apparatus described in Specification No. 16,960, A.D. 1899, controlled by air pressure admitted through valves, a short-circuiting switch was provided, closed against spring pressure by the increasing pressure of the air when the resistance has been reduced to a minimum. The valves are now modified to ensure that, on reducing the air pressure, the switch shall be opened before the resistance is increased. The controlling valve described in the specification referred to, may be made with an air discharge opening, which can communicate through a side channel directly with the pipe connected to the resistance apparatus and the switch. 2 claims.

14,373. "Improvements in and in connection with electrical fuseboards." H. C. Farrell. Dated August 11th, 1900. A fuseboard is arranged with the fuse wires attached to removable bridges. In the form shown, the base is formed with a dividing bridge against the L-shaped contacts are fitted. The bridge is fitted with spring contacts, the fuse being placed in a groove. In a modified form, the bridge on the base is omitted, and the bridge carrying the fuse is shaped like the letter E, the central projection passing between the contacts. The contact surfaces in these arrangements are thus at right angles to the lane of the bridge-pieces. 3 claims.

14,396. "Improvements in apparatus for galvanising needles, sewing needles, and the like." E. Paul. Dated August 11th, 1900. Relates to plating small articles, such as pins, needles for machines, sewing needles, buttons, spokes, and the like. 2 claims.

14,409. "Improvements in electric meters." J. Harris, U.S.A. Dated August 11th, 1900. Relates to watt-hour meters. 3 claims.

14,420. "Improvements in combined electric meters and demand indicators." A. Wright. Dated August 11th, 1900. A maximum demand indicator, applicable to the rotating spindle of a supply meter of any construction, consists of a non-return pointer of any kind, movable in opposition to a spring or its equivalent by fluid frictional connection with the spindle described, applicable to the supply meter described in Specification No. 177,641, A.D. 1878. 4 claims.

14,422. "Improvements in switches and apparatus for use in starting electric motors." A. Adams. Dated August 11th, 1900. A motor starting and controlling switch is so arranged that the resistances are slowly cut out when the main switch is closed, and electro-magnetic devices are provided for releasing the locking arrangement of the switch in case of over or under load. 7 claims.

14,458. "Improvements in telegraphic relays." C. E. Wilson. Dated August 13th, 1900. Relays for telegraphic purposes, such as wireless and other signalling. A diaphragm of conducting material or having a conducting portion on each side extending from the centre to the edge, is mounted in an insulating ring. Two adjustable contacts are brought approximately up to the diaphragm, or one of them may be in contact therewith. The local circuit may be nominally either closed or open. 7 claims.

14,463. "Improvements in apparatus for electrolysis." P. Schoop. Dated August 13th, 1900. Relates to apparatus especially intended for electrolysing alkaline and alkaline-earth salts for the preparation of bleaching liquids, and refers to the apparatus described in Specification No. 13,074 A.D. 1899. 2 claims.

14,506. "Improvements in and relating to dynamo-electric machinery." A. G. Brooks. (C. L. Cotton.) Dated August 14th, 1900. Relates to a method of obtaining a constant electromotive force at varying speeds by varying the strength of the field in inverse proportion to the variations in the speed of the armature. The field is provided with a magnetic shunt upon which, in addition to the usual shunt coil, is arranged a neutralising-coil in connection with an auxiliary armature winding. 8 claims.

14,525. "Improvements connected with electric controller brushes." J. Y. Johnson. (Rikar Motor Vehicle Co., U.S.A.) Dated August 14th, 1900. Guards for controller brushes prevent the brushes from catching on the controller segments. A guard-plate having a depending lip is arranged in connection with each brush, so as to prevent excessive vibration of the brush, which is lengthened to engage the lip. The brush is thus unable to spring in front of one of the segments. 3 claims.

14,550. "Improvements relating to the insulation of electric conductors." H. H. Lake. (N. Tesla, U.S.A.) Dated August 19th, 1900. Relates to insulating electric conductors by surrounding them with water or aqueous solutions and freezing the same by currents of cold gas such as air, hydrogen, carbonic acid, ammonia, or illuminating gas. 7 claims.

14,552. "Improvements in conduits for electric conductors, water and the like." H. Tugby. Dated August 14th, 1900. Multiple-channelled pipes or conduits for electric conductors, water, &c., are formed of earthenware, glass, metal, &c., in lengths which fit together with spigot and socket joints. The channels may be of any shape and any arrangement of grouping. 2 claims.

14,558. "Improvements relating to the transmission and receiving of telegraphic signals." C. F. R. Blechmann. Dated August 14th, 1900. Relates to a system of wireless telegraphy in which the transmitter emits a beam of rays by means of a lens, and each receiver is arranged with a number of coherers set in the focal plane of a lens so as to determine whence a message comes. A set of coherers arranged in the focal plane of a lens inside a case opaque to electric waves, a shutter is described. The case may be mounted on gunbals. The coherers are arranged in a local circuit with the indicators, battery and relay. The circuit of the relay includes a relay for operating the decohering tapper lever and for controlling the local circuit of the receiving instrument and bell. 4 claims.

14,568. "Improvements in toll-collecting machines for telephones." R. Haddan. (American Toll Telephone Co., U.S.A.) Dated August 14th, 1900. Relates to apparatus for collecting tolls for the use of telephones, and cannot well be described without reference to a diagram. 16 claims.

14,572. "Process for obtaining pure alumina from bauxite." C. M. Hall, U.S.A. Dated August 14th, 1900. Pure alumina is obtained from bauxite by first calcining the bauxite if necessary, and then fusing it in an electric furnace with or without the addition of suitable reducing agents, preferably aluminium or an alloy thereof, and maintaining the materials in a fused condition until the impurities have been reduced and separated. 1 claim.

14,582. "Improvements in and connected with electric furnaces." R. Chavarria-Contardo. Dated August 14th, 1900. An arc lamp is constructed for making calcium carbide, or reducing metals or other materials. The arc is formed between two electrodes passed through vertical end walls. Each side of the hearth slopes at an angle suitable to expose the materials to the radiation from the arc. 7 claims.

14,633. "An improved system of electric lighting and apparatus or devices therefor." P. Lapertot, G. Villard and L. Pignaud. Dated August 15th, 1900. Lamps are supplied with current intermittently, and coils having "self-induction or capacity" are included in the circuits to give a sudden rise in the potential at the moment of making the circuit. A form of apparatus for this purpose, and termed a lifting transformer is described. 5 claims.

14,704. "Improvements in transmitters for electrical waves or the like apparatus." C. G. G. Braunerhjelm. Dated August 16th, 1900. Relates to arrangements of stations for wireless telegraphy, in which an aerial conductor terminates or passes through a chamber of glass or other dielectric material. The chamber is exhausted of air, and behind it is placed a curved electrically opaque screen. The conductor may be branched into the chamber or an ordinary aerial conductor may be employed with the special conductor and the screen. 3 claims.

14,723. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated August 16th, 1900. Relates to a magnetic apparatus for cutting out a generator should it cease to supply energy and commence to receive it, and consists of an improvement upon the arrangement described in Specification No. 25,733, A.D. 1897, in order to dispense with flexible connections. 2 claims.

14,743. "Improvements in electric cut-outs and the like." H. F. Craigalher. Dated August 16th, 1900. To prevent arching and to readily replace a fuse. The appliance is made in three parts—(1) the cover; (2) an inner piece carrying the fuse and connected to plug contacts; and (3) the base carrying sockets to which the main conductors are connected. 3 claims.

14,784. "Improvements in apparatus for use in wireless telegraphy." T. J. Bowlker. Dated August 17th, 1900. Relates to arrangements of the various parts of the apparatus in wireless telegraphy. 5 claims.

14,788. "An attachment to ceiling roses for raising and lowering central hole weights or fixing electrical fittings." R. W. Braham. Dated August 18th, 1900. Relates to supporting lamps. A frame containing one or two pulleys to carry the flexible conductors of a pendent, or a hook, to carry an electrolier, is supported vertically below a ceiling rose by a curved arm of a ring, which may be held between the cover and base of the rose. The arm has a lateral or central hole, through which the conductors are passed. 2 claims.

14,823. "Improvements in apparatus for automatically regulating the pressures or supply of fluids in pipes and the like." E. Bert. Dated August 18th, 1900. For regulating the supply of gas, the supply pipe is connected with an indicator provided with two movable stops, which are arranged to stand on either side of a needle, at the moment when it marks the regulation pressure it is desired to maintain in the apparatus. Any rise or fall in the pressure will then cause the needle to make contact with one of the stops, thereby closing an electric circuit to the motor, which is thereupon set in motion to close or open the valve as required. 3 claims.

14,841. "Improvements in means and apparatus for telegraphing and controlling various mechanisms from a distance without wire or other connections." J. T. Armstrong and A. Orling. Dated August 18th, 1900. Relates to arrangements for telegraphing or controlling apparatus, such as torpedoes at a distance, by means of electro-magnetic radiations. Any suitable transmitter may be employed, but preferably as stated in the provisional specification, that described in Specification No. 19,640, A.D. 1899. 9 claims.

14,893. "Improvements in electrical measuring instruments." L. B. Atkinson. Dated August 20th, 1900. A glass bulb provided with a hanging weight and an upwardly projecting stem floats in liquid in a closed glass tube, the upper part of which is surrounded by a coil to act on a magnetic wire carried in the float. The tube and coil are enclosed in a metal tube and a cap attached to a supporting bracket. The coil is connected by vertical sleeves with wires carrying terminals, which may be directed towards either the front or the back of the instrument. The lower part of the coil may be wound thicker than the upper part, and surrounded by additional resistant wire wound on a longitudinally corrugated paper tube. The glass tube is supported on an adjusting screw, and is held forward by a spring in the lower metal tube, which is slotted in front, and carries a scale. 5 claims.

14,896. "Improvements in or connected with sectional conductor, street, or road electric railways." J. Milnes. Dated August 21st, 1900. The main conductor is led into the inner box, where it is bared and attached to a feeder, the box then being filled up with insulating material. The movable part slides over the feeder, to which it is connected electrically by flexible attachments, and is lifted by magnets on the vehicle into contact with the underside of a sectional exposed conductor. This movable part may be constructed of iron and copper, with spring carbon blocks to take the sparking, or the carbon contacts may be mounted centrally, instead of at the ends, and the feeder may be made hollow to receive the plunger, instead of surrounding it. The sectional conductor is laid in a slab or bar of insulating material, and that part of the conductor and its support over the switchbox is made removable, to act as a lid. 9 claims.

14,924. "Improvements in electric accumulators." H. Rose, J. Halifax and C. H. Antrobus. Dated August 21st, 1900. The negative plate consists of a plate of lead bent to shape, and provided with a number of perforations. 2 claims.

14,943. "Improvements in switchboards for telephone stations." M. I. Baird. Dated August 21st, 1900. Telephone switchboards are provided with jacks having returning bars for automatically shifting the position of the plug under various circumstances, and cannot well be described without reference to a diagram. 18 claims.

15,001. "Improvements in electric measuring instruments." A. Honig. Dated August 22nd, 1900. A continuous current ammeter or voltmeter consists of an axle carrying a pointer and controlled by gravity or a spring, and also carrying a ring-shaped permanent magnet with a small air-gap at one side; stationary current conductors are situated in the gap, so that the magnet poles move across them when the axle turns. The conductors are part of a coil of wire wound in a former which has a flat portion situated in the gap. Such a voltmeter for use on supply feeders may be wound with double wire, one wire being connected between the feeders, and the other to the ends of main resistance, so as to reduce the effect of the first wire and compensate for the drop in pressure on the feeders. An ammeter for large current may have a conducting strip instead of a coil, a part of the strip being bent into a vertical plane near the axle, this strip may be shunted by the main conductor. By making the coil or the conducting strip of varying thickness in the air-gap, any desired scale can be produced. 3 claims.

15,019. "Improvements relating to the recovery of tin, and the simultaneous generation of electric energy." R. N. Gould. Dated August 22nd, 1900. Relates to a process for recovering tin, &c., from scrap, and also generating electrical energy. The tin scrap is made an electrode in a vessel containing brine or the like, the other electrode being made of carbon or the like. The tin partly dissolves forming tin chloride, and is in part precipitated. At the same time an electric current is generated and may be utilised. Preferably it is employed in completely stripping the tin from the partly stripped scrap, this operation being carried out in a suitable tank placed in the circuit. 4 claims.

15,021. "Improvements in the manufacture of carbon electrodes for arc lamps." V. Alexandroff. Dated August 22nd, 1900. Relates to electrodes for arc lamps. These are made of carbon mixed with oxikes or salts of magnesium, aluminium zinc, copper, silver, thorium, cerium, zirconium, yttrium, calcium, or other metals suitable for giving light with less expenditure of energy than when pure carbons are used. 2 claims.

15,073. "Improvements in electro-plating apparatus." H. R. Boissier. Dated August 23rd, 1900. Relates to coils and receptacles, electrodes, electrolytes agitating, and is too complicated to be well described without reference to a diagram. 5 claims.

15,095. "Improvements in electrical demand indicators." A. Wright and Ronson Manufacturing Co. Dated August 23rd, 1900. Any demand indicator operated electro-magnetically is made with a considerable amount of iron to obtain powerful action, the residual magnetism being unimportant in such indicators. In the form described, a coil carrying the current to be indicated contains two iron cores with end arms. One core being stationary, the other core is rotatable on its axis by the magnetic repulsion between the arms, and carries fast and loose pointers over a scale, one being movable by a projection on the other and resting at the point of maximum deflection. Instead of using a separate maximum pointer the movable core may carry a ratchet wheel or its equivalent in engagement with a stationary pawl or other detaining device to prevent reverse motion, as described in Specification No. 18,811, A.D. 1897. The movable core may carry a vane dipping in glycerine, or be otherwise retarded in its movements. 5 claims.

15,123. "A new or improved electrical arc lamp." Nottingham, Ltd., and W. E. Symons. Dated August 24th, 1900. A solenoid lamp has a top-plate supporting the differentially-wound solenoid, which may be a foot long, and one or two iron side tubes carrying the insulated lower carbon holder connection with which is made by an insulated conductor passed through one of the tubes. The upper carbon holder is attached to an iron core which has iron arms guided by the side tubes, actual magnetic contact being prevented by interposing pieces of copper gauze, or by using iron tubes case with brass or copper. Connection with the upper carbon holder is made by a flexible conductor. 1 claim.

15,138. "Improvements in hoists or elevators." C. West. Dated August 24th, 1900. An electrically-driven hoist or elevator is operated by a motor secured to the cage and gearing with drums on which are wound and unwound the suspending ropes fixed to the upper end of the well. In a modification, the weight of the cage, and part of the load, is balanced by weights, and ropes secured to the bottom of the well are wound and unwound on drums secured on the same shafts as the drums.

15,167. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (W. J. Davis, U.S.A.) Dated August 25th, 1900. In order to prevent hunting in synchronous apparatus, such as rotary converters, they are supplied in parallel during periods of light load, and independently when the load is heavy, and cannot well be described without reference to a diagram. 7 claims.

15,168. "Improvements in commutators for electric machines." British Thomson-Houston Co. (J. T. H. Dempster, U.S.A.) Dated August 25th, 1900. The commutator bars are mechanically locked together below the brush tread at a point between their ends, so as to prevent distortion or displacement. The bars are formed on their undersides with keyways for receiving an insulated metal key constructed in sections, which are separately secured to the arum by bolts. When all the sections are in place, they are further secured by end plates in the ordinary manner. 8 claims.

15,169. "Improvements in rectifying alternating electric currents." British Thomson-Houston Co. (E. Thomson U.S.A.) Dated August 25th, 1900. Relates to means for maintaining synchronism in rectifying alternating currents, and so preventing sparking. The motor for driving the rectifying commutator is supplied with current having a higher frequency than the current to be rectified. In one arrangement the generator supplies the current to be rectified through a transformer to the collector of a rectifier. The synchronous motor is supplied with a current of higher frequency by means of an auxiliary generator, the number of poles on the machines being arranged to produce the desired effect. 5 claims.